Issued Weekly by the

Hill Publishing Company

JOHN A. HILL, Pres. and Treas. ROB'T MCKEAN, Sec'y.

505 Pearl St., New York.
6 Bouverie St., London, E. C.
Unter den Linden 71, Berlin.

Subscriptions payable in advance, $5.00 a year for 52 numbers, including postage in the United States, Mexico, Cuba, Porto Rico, Hawaii, or the Philippines, $6.50 in Canada.

To foreign countries, including postage, $8.00 or its equivalent, 33 shillings: 33 marks: or 40 francs.

Notice to discontinue should be written to the New York Office in every instance.

Advertising copy should reach New York Office by Thursday of week before date of issue.

Entered at New York Post Office as mail matter of the second class.

Cable Address, Engminjour, N. Y.

CIRCULATION STATEMENT

Of this issue 9300 copies are printed.

None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.

Contents

PAGE

Editorials:
Respecting Metallurgical Patents 343
Cobalt 344
Laboratory Motion Study..... 344
Metallics—By the Way..... 345
Exports of Copper..... 346
The Steel Tariff Bill..... 346
Ray Consolidated 346
Correspondence and Discussion:
The Niter Assay....Use for Vanadium Iron Bearing Sands....Where Should the Primer Go?....The Experiment Station Bill....Geology Applied to Mining....Literary Taste of Miners....Caucasus Copper Co..... 347
Details of Practical Mining:
*Finger-pin Timbering in Swelling Ground....Thawing Frozen Water Pipes....*Rope Idlers for Inclined Shafts....*A Concrete Trench for Pipes....*Reheating Air for Drills....*A Mine Chute Gate....*Stopping Leaks in Air Receivers....Hints on Buying Pumps ....*Turning a Large Sheave....*Hoisting Engine Repair Job....Reproducing Mounted Plans....Ejectors for Mine Drainage 350
*Graphic Solution of Evaporating Problems 354
Firebrick at High Temperatures... 354
High Duty Gravity Stamps..... 354
The Heraeus Resistance Thermometer.....A. Schramm 355
Exhaust Steam Turbines..... 356
*Central Compressing Plants at Butte 356
Transvaal Mining Notes..... 357
Explosives for Coal Mining..... 358
*The Davis Mine Anemometer..... 358
Density of Aluminum..... 358
*The California Gold Dredge—I. Robert E. Cranston 359
Review of Cobalt..... 363
Secondary Sulphide Enrichment. Horace V. Winchell 364
Cost of Power Installations..... 367
*An Adjustable Elbow Union..... 367
*A Gravity Filter Plant. C. J. Stone 368
Effect of Sulphur on Firebrick..... 369
Improvements in Crushing Rolls. C. Q. Payne 370
Mineral Deposits of Bulgaria..... 371
*History of a Once Famous Arizona Gold Mine..... 372
New Publications 373
Personal, Obituary and Societies... 374
Editorial Correspondence 377
Mining News 379
Markets 385

*Illustrated.

The Engineering and Mining Journal

Vol. 93. FEBRUARY 17, 1912. No. 7.

Respecting Metallurgical Patents

We shall stop far from saying, or even implying, that there is nothing new under the sun; that all kinds of physical forces are known and that all possible reactions have been studied; if we should indicate any such ideas some Marconi or Curie would rise promptly to refute us. Confining our thoughts to the single domain of metallurgy, we are nevertheless inspired with the idea that the wealth of practical experience and scientific research has reduced the chances for any new generic discovery to a very small compass; and indeed there is not left any large leeway for ingenious combinations. This does not mean that we are likely to halt in our progress (our idea is quite the contrary), but it does mean that the chances of anyone monopolizing the results of certain steps in advance, or even reaping extraordinary rewards from them, are no longer to be expected as a common thing. In other words, the chances for securing any sweeping metallurgical patents, capable of being sustained, are relatively small.

There are two kinds of ingenuity. One evolves the idea; the other develops the practice. Without doubt there are thousands of useful ideas discarded, and more or less forgotten, because they failed in their first applications, perhaps simply because they anticipated their time, perhaps for some other reason. Inventors may have a good idea and fail utterly to make it work in practice until someone comes along and learns how to do the thing.

Miss Everson's patent, taken out in 1886, for the flotation of sulphide minerals, is an example of the fact that epoch-making periods in metallurgy do not as a rule follow the discoveries of new principles, but rather depend upon the practical application of known reactions; witness, besides the present flotation processes, blast roasting, pyritic smelting, the bessemerizing of copper matte, converting on basic bottoms, the development of the long reverberatory furnace of the present day, the cyanide method for gold and silver ores, the air-agitation of cyanide pulp, the beneficiation of blende-marcasite ores.

Investigators who have displayed ingenuity in these problems have, in most cases, profited more from their superior knowledge and earlier skill in the art than from generic discovery or from any control of the processes themselves, except when they patented a particular form of apparatus that was required for the successful working of a process. There has been some exception to this, especially where an imposing array of legal talent and threats of suit have enabled patentees to "stand up" the metallurgical world, as it were, and take toll of the operating companies. Such cases have been rare in America where popular sentiment is opposed to the payment of royalties on processes, doubtless for the reasons that we have herein outlined. Nevertheless, there has been no hesitation about paying to a patentee a reasonable round sum in lieu of royalties, in many cases not so much as a recognition of his patents as a consideration for his knowledge, it often being cheaper for a buyer to "learn how" in that way than by engagement in independent experimentation. All the way up the ladder of our metallurgical progress the "learning how" to apply previous knowledge has been of more importance than the introduction of new processes of radical invention.

Thus in the beneficiation of blende-marcasite ores in Wisconsin there was an example of gradual development, the cumulative result of individual effort of a number of metallurgists. The practical work in the magnetic separation of these ores was done in recent years and was put upon a stable commercial basis by the simple development of a long known principle. It had been a matter of common knowledge that these two minerals could be separated by magnetic machines after a roasting to make the marcasite magnetic,

and plants were built to utilize this principle, but for many years they were failures, and success was achieved only when it was determined at just what temperature the roasting should be done, in other words, when the operators became more skillful. No attempt was made to patent this superior skill in connection with a process that was long since known. Some of the devices or apparatus, however, were patented. There is a difference between skill and invention, and fortunately skill is not patentable, else the industries of the world would be in the hands of a few persons in each industry.

Cobalt

If the statement frequently heard that "Cobalt has seen its best days" means that the maximum production of high-grade ore has been or is soon to be reached, it is probably true; if it means that the output of refined silver from that camp has reached its height and from now on will decrease, there is ground for argument. It is generally believed, however, that Cobalt's future rests upon its ability to do what many other districts have done, when the "bonanza" ore has petered out—to get down to systematic mining and maintain a large, profitable production from low-grade ore.

Since the discovery by La Rose six years ago, the history of the camp has been marked by exceptionally narrow, high-grade deposits, high costs and shallow depth of workings. The profitable mining and reduction of this high-grade ore has been governed by many favorable conditions, not least among which has been the moderate cost of installation of plants, made possible by the shallow depth of the workings and the small daily tonnage required. A problem that had to be solved early in the life of the district was the profitable treatment of the somewhat refractory ores. The advantages and disadvantages that attend the mining of narrow, high-grade veins, have been enjoyed and endured by Cobalt up to the present and probably will be for some time to come.

There are unfailing signs now that changes are taking place in the physical conditions of the older properties. There are indications that the high-grade ore that has made these properties and the name of Cobalt famous, is becoming depleted without the addition of reserves of equal grade, to offset such loss. Of course, if nothing is developed to replace this high-grade ore, the camp must soon decline. It is the realization of this condition, doubtless, that has caused the feeling that the best days of the camp have already passed. There are at least two factors, however, that should not be lost sight of—the known presence of low-grade ores and the comparative shallowness of the workings. The policy of prospecting at considerable depth is now being pursued at some of the mines, also the profitable treatment of the low-grade ores is being successfully extended. It is to the possibility of treating profitably this class of ore from present or greater depth that Cobalt must look, to maintain its past record as a producer of silver.

Laboratory Motion Study

Quite as striking a thing as the chemists' search for new methods is the average chemist's reluctance to adopt new apparatus. This may be partly due to training; we know of one university which prides itself on forcing the student to rig up primitive apparatus for all purposes, claiming that the manipulative faculty is developed in this way. Even in those schools which do not point with pride to this state of affairs, the student usually makes one determination at a time, and the idea that if he enter a works' laboratory later he may have 50 determinations embracing a dozen elements or radicals all going at once, neither occurs to him, nor is impressed upon his attention. Consequently its logical conclusion, that the art of commercial analysis is in getting determinations to look out for themselves, while the chemist does other work, never intrudes itself upon him. This does not seem true in other engineering lines, where the student is told of automatic apparatus even though he does not use it.

In the great iron laboratories the requirements of speed and capacity seem to have driven even the chemists to machines, and here power-driven grinding apparatus, automatic stirring apparatus, and the like, would satisfy even Mr. Taylor's requirements. But the average chemist seems still to need to have called to his attention that automatic multiple-stirring and -filtering apparatus, automatic funnel-filling devices for filtering large quantities of liquid, burettes and pipettes which must fill to their zero marks, are all things which should be looked into and, usually, adopted. On the side of furnace work in assaying, Doctor Keller's apparatus has reduced everything to multiple handling, and as they are unpatented, these at least can be used without any great expense. Indeed, it will probably pay any employer to consider whether his chemist is keeping pace with his master mechanic in the adoption of machinery, and if not, to find out why.

James J. Hill is one prominent financier who does not agree with Messrs. Gary, Carnegie and Perkins that the Government should undertake to fix maximum and minimum prices. Mr. Hill told the Stanley committee that the principle of competition in business will prevail as long as the law of the survival of the fittest operates, and he predicts that that law will operate forever. Evidently his wrestling with the forces of nature has taught him a profound respect for its immutable laws. In the management of his hippodrome the Hon. Stanley is to be congratulated upon securing so admirable a performer as Mr. Hill, from whom even he may learn something if he pays attention.

The remarkable rise in ocean freight rates which has taken place in the last few months will probably have some effect in reducing the imports of Swedish and Spanish iron ores in this country. It appears to be due to the activity of trade in Europe and the increase in tonnage offered. It is sufficient to add materially to the cost of imported ores, and in some cases to turn the balance in favor of Lake ores. Cuban and Newfoundland ores are not so much affected, since they are carried chiefly in vessels owned by the iron companies or under long charters.

Lake Superior iron-ore prices for the coming season are under discussion, but for reasons easily understood, it is probable that there will be no open agreement this year among the companies having ore to sell. Besides the reluctance to enter into what may be called a combination, it is understood that efforts are being made to sell to Eastern furnaces, and sellers want to be free to make quiet concessions to secure that business. In any event it is probable that buyers will get the benefit of the freight reductions on the Minnesota railroads.

Metallics

In assaying cupel bottoms, the extraction is bettered by exceedingly fine grinding.

When an iron rod is dipped into molten slag and withdrawn, if the slag is siliceous it will drip in long strings; if basic, as drops, and usually, when aluminous, will form thin sheets.

It nearly always will pay to precipitate copper-mine waters, in one known case an effluent containing only 0.08% Cu was treated at a profit. The best method to precipitate is by old tin cans, and not by leaving picks and shovels in the drainage ditch.

In a power plant having a great number of pipes, it is often a good idea to paint each kind with a stripe of a distinctive color, i.e., green for water, blue for air, white for steam, etc. The subdivision can be still further carried out into separate symbolism for high and low pressure.

The following comparative cost figures have been compiled by the Corrigan-McKinney company, in testing acetylene lamps at its mines at Crystal Falls, Mich.: Cost of candles per day per man, 5c.; sunshine, 2½c.; calcium carbide, 1¾c.; the cost of the lamps is not included in these figures.

In many cyanide mills the lime is added dry to the ore, the lime going slowly into solution. Since some ores develop their acidity progressively, the above method is of especial advantage, as the lime becomes available at successive periods in the process. It is preferable that the lime be not coarser than about 40 mesh, otherwise some of the available lime may be discharged with the tailings.

At the Alaska-Treadwell cyanide plant, one 5x22-ft. tube mill grinds 88.75 tons of concentrate per 24 hours. The pulp fed contains 38.5% moisture and grades as follows: On 100 mesh, 48.7%; on 200 mesh, 41.5%; through 200 mesh, 9.8%. The discharge shows: On 100 mesh, 10.1%; on 200 mesh, 26.4%; through 200 mesh, 63.5%. The tube runs at 27 r.p.m. and takes 59 hp. when just half filled with pebbles.

The presence of over 1% of manganese makes steel brittle. The brittleness increases with the addition of more manganese until, when 4 to 5½% is present, the steel can be crushed under a hammer. With further additions of manganese, up to 7% the brittleness does not increase. Upon addition of as much as 7% manganese an entirely new set of properties is acquired by the steel; these new properties are marked at 10% and reach a maximum at 12 or 15% manganese. Steel containing 12 to 15% manganese possesses great hardness and ductility.

By the Way

Dispatches announce the finding, on Feb. 6, of a large piece of fan coral embedded in sandstone, in the Hilson coal mine, in Park County, Montana. The coral is stated to be of a delicate pink color and in perfect condition.

Railroads, probably more than any other corporations, are harassed by inventors. The other day, recounts the Boston *News Bureau*, one walked into the office of a western road with an invention calculated to make the passenger think twice before he complains of dust. It was a patent window sill to catch all dust forced into the car. The inventor said that he had analyzed the dust in trains coming across Nevada and found a high percentage of precious metals, and that if his sills were installed the company would get some $10,000,000 a year out of dust kept off its passengers. Whether the railroads would be allowed under the commodities clause to combine mining with railroading is not obvious. Whether miners would get more out of dusting than digging is equally obscure. But one thing is certain, the colored whiskbroom industry will suffer if ever the value of that Nevada dust is noised abroad.

A mining engineer has forwarded us some generously tinseled twaddle offered by a so called Boston "bond and investment security" house in support of one of the Curb stocks in that city. The property is supposed to consist of about 1600 acres of placer ground besides 17 rich quartz claims, the veins of which "run north 20 deg. east, the same as all the rich veins in the State of Nevada. The direction of these veins is of great importance, as it means that the value will not pinch out and will get richer as they go down, and no man who has ever been there can say different." The company has had "a highly recommended mining expert" visit the property, and the document in question is offered in response to a request for the report of this person, who poses alternately as adviser and stockholder. We surmise that he is a graduate of the Curb Market School of Mines. The report has the following disingenous beginning: "Having visited the mines of the —— —— company, and spent one week looking over the property, I am going to put out a report on same—not for the purpose of raicing the price of the stock, as this will take care of itself when the proper time comes. . . . . I have tested the placer ground of this company; I know it is rich. I do not think officers of the company know of this placer ground. . . . . It is estimated that there is in this placer ground from $10,000,000 to $15,000,000 [You may add a few ciphers for yourself, if you like] and with an outlay of $2000 they could start the placer ground and get results right from the start. The gold is course, and there is not any dirt to remove before the pay dirt is struck. . . . . They have found nuggets that went $2000 on this ground and they are common that go from $10 to $20 each." One would think that instead of working State St. and the tight corners of New England, these Curb Market graduates would retire to this Eldorado of Nevada, and once or twice per month gather a cupful of these $20 nuggets that are so common. They are out for fame, however, and as philanthropists are offering these wonderful opportunities to hard-working New England schoolteachers and tradespeople, through the medium of the Boston Curb. Passing over the fact that there are some equally invaluable shares on exchanges in other cities, do you wonder why "mining shares" have the reputation they bear among many laymen, and why, when a man comes East, limited by facts and a real mine, he has difficulty in getting even a hearing.

Our advertising department has always rightly claimed that advertising in the JOURNAL brings business. Here is evidence of it in a letter which a gratified engineer, whose card appears in our professional directory, has forwarded to us.

Mr. Channing J. Parke,
Consulting Mining Engineer,
42 Broadway, New York.

Dear Sir:

Please send your references for abilities and integrity, etc., immediately. I note your ad in Engineering and Mining Journal. I may need your assistance in a very large deal if your capabilities and honor are satisfactory. Are you in close touch with Mr. John Hays Hammond, E. M.?

Yours respectfully,
JOHN SMITH.

This is fame!

Since Jan. 26, the stock of the new Inspiration Consolidated Copper Co. has declined from 21½ to 18, and it is a thing for which everybody is suitably apologetic, says the *Evening Post*. The stock should have gone up; that it went down instead of up is variably explained. One apologist says an insider was in great haste to collect his profits; another says that a lot of traders on the Curb had loaded up and have been selling out; another more adroitly explains that as everybody expected the price to rise, the insiders thought to shake out a lot of weak speculators and get some cheap stock for themselves by allowing the price to decline at first, and that it will, of course, advance later. No copper promotion has recently been launched so enthusiastically. Everybody who is anybody in copper is on the directorate of the new company; it is the most distinguished copper-company directorate ever seen. That is why Wall Street people began to buy the new stock as soon as it was accessible on the Curb.

Exports of Copper

The Copper Producers' Association has issued the following circular in relation to the discrepancies between its statement of export deliveries and the figures given in the reports of the Bureau of Statistics, to which reference has heretofore been made.

The 1910 Exports

In a statement issued July 14, 1911, by the Copper Producers' Association, with the approval of the Federal Bureau of Statistics, it was stated that omissions had been discovered in the published Government figures for copper exports in 1910 amounting to 13,209,500 lb. In the "Summary" of the Government Bureau of Statistics for December, 1911, recently issued, the total copper export statistics for 1910 have now been corrected by addition of the quantity shown above, and compare with the earlier figures as follows:

	Old Gov. Figures for 1910	Corrected Gov. Figures for 1910
Under "domestic mdse".	695,107,043	708,316,543
Under "foreign mdse."	55,857	55,857
Total	695,162,900	708,372,400

Inasmuch, however, as this substitution of figures has been made in the official publication without any explanation or comment and thus might readily be overlooked, or might cause confusion to those who did notice it, attention may well be called to this correction.

The Government export figures as they now stand compare with corresponding statistics of the Copper Producers Association for the years since that organization has been in existence as follows:

	1909	1910	1911
Government	683,905,254	708,372,400	786,553,408
Copper produc'd	680,942,620	722,431,494	754,902,233
Difference	+2,962,634	—14,059,094	+31,651,175

The total for the three years is: Government figures, 2,178,831,062 lb.; Copper Producers', 2,158,276,347; difference, 20,554,715 lb. excess of Government figures.

Causes of Difeerences

As has been previously pointed out, exact agreement between the two sets of figures is impossible because of overlap in time of reporting. Over a period of years the Government figures should average somewhat higher than those of the Copper Producers', because of inclusion in the former of exports of old copper and scrap, items not embraced in the Copper Producers' reports.

Including the net result of overlap at the beginning of 1909 and at the end of 1911, the Government figures for the three-year period are seen to have been more than 20,000,000 lb. higher than those of the Copper Producers' Association. The Government excess of more than 31,000,000 lb. for 1911 is mainly due to adjustment of an abnormally large opposite overlap difference, known to have been over 27,000,000 lb., that existed at the end of 1910.

The Steel Tariff Bill

Washington Correspondence

Hearings on the House bill revising the steel tariff have been in progress throughout the past week before the Senate Finance Committee. It is planned to continue them up to Mar. 1, and perhaps longer than that. Among those who have appeared during the first few days of the hearings are manufacturers of saws, of steel pens, and of heavy iron products, the chief representative of the latter being Charles M. Schwab. All of the witnesses have taken strong ground against the rates fixed in the bill, alleging that they would be disastrous to the industry, and particularly to those branches of it represented by the speakers. It is probable that within the next week a considerable number of witnesses will lay stress upon the effect of the bill upon the manufacture of heavy iron and steel products.

Mr. Schwab, in his testimony, put the chief stress upon the effect of the measure on the Eastern steel-producing plants, which, he said, would be practically driven into a state of bankruptcy if the bill were to go into operation. He said that he himself would feel like going out of business under such a condition, and asserted that the Bethlehem Steel Co. had made only a small dividend since its organization. Relatively little detailed information about costs were furnished; this being due, doubtless, to the fact that the subject has been so fully covered by the Bureau of Corporations in its recent report. Great stress, however, was laid upon conditions abroad, as to which the Bureau of Corporations had nothing to say, merely alleging that it had not succeeded in getting any information from the books of foreign iron- and steel-producing concerns. It was alleged, as usual, that wages were so much lower in foreign countries that it was wholly impossible for the United States to contend against them. Perhaps the most difficult proposition which Mr. Schwab had to meet in this connection was found in the fact that the report recently issued by the Bureau of Labor concerning conditions at the Bethlehem plant showed the existence of excessively low wages and long hours of labor there. Mr. Schwab met this by simply alleging that the statements made in the report were false. Former Congressman J. T. McCleary, who has appeared for the Lackawanna Steel Co., has told the committee that that plant is able to earn only about 0.25 per cent. on its stock after providing for fixed charges and a reasonable depreciation allowance. Other witnesses take very much the same point of view, and it would appear that quite as much hostility to the rates fixed on the heavy products as to those established on the more highly manufactured articles will be exhibited throughout the hearings.

Ray Consolidated

A recent notice to stockholders of the Ray Consolidated company, states that a special meeting will be held on Feb. 28, for the purpose of voting upon a plan to increase the capital stock to 1,600,000 shares, an increase of 200,000. The purpose of this increase is to acquire a controlling interest in the Ray Central Copper Mining Co. It is stated that the Ray Central orebody has been developed extensively, and that there has been shown to be several million tons of ore of approximately the same grade as that of the Ray Consolidated, and also a smaller body of much higher-grade ore. Prior to this it has been impossible to arrive at acceptable terms. The present situation was precipitated by the recent issue of $1,800,000 worth of first-mortgage, 6% bonds of the Ray Central company, convertible into stock at $2 per share, of which the underwriters were compelled to take and pay for $1,717,000 worth of the par value, the stockholders having subscribed for only $83,000 worth of these bonds. The Ray Consolidated has now received an offer whereby it may acquire the $1,717,000 par value of bonds upon the condition that it shall offer the holders of all the outstanding stock of the Ray Central company, amounting to 1,000,000 shares, the right to exchange eight shares of the Ray Central stock for one share of the Ray Consolidated.

These bonds to be acquired, if converted into stock, will give the Ray Consolidated 858,500 shares of the Ray Central stock, together with that of the stockholders who have already agreed to exchange on this basis. This, it is stated, will insure the Ray Consolidated company a large majority of the shares of Ray Central. It is purposed, after the offer of exchange has been made to the holders of the remaining outstanding shares of the Ray Central company, to acquire by conveyance all the physical property and assets of the Ray Central company.

As the orebodies of the Ray Central company are believed to be easily accessible to the workings connected with the No. 1 shaft of the Ray Consolidated, the consolidation, it is claimed, would make possible the extraction of several million tons of ore, adjacent to the boundary lines of the two properties which are not now available by either company. It is stated that the Ray Consolidated, with its mining, railroad and milling facilities, can mine and treat the Ray Central ores at a lower cost than the Ray Central company could.

Correspondence and Discussion

Views, Suggestions and Experiences of Readers

The Niter Assay

In the JOURNAL of Dec. 20, 1911, p. 1262, there appeared an article on the niter assay, by P. D. Wilson. Some observations on this article and the niter method, made not in a spirit of adverse criticism, may produce a few points unfamiliar to some of your readers.

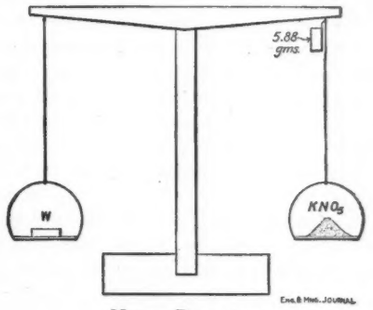
The curve for obtaining required niter from the sulphide content of an ore is of limited use, as the assayer generally has not this information; and when available it is useful only when, as pointed out, the sulphur is combined in a class of sulphides for which the curve has been determined. Of course, the sulphide sulphur must be distinguished from the oxidized compounds. With miscellaneous sulphides we have found the method rather unsatisfactory.

Except where a class of ores is uniform in characteristics, it is next to impossible to estimate the niter required, and it is generally conceded that a preliminary assay is necessary for satisfactory work. Under these conditions the curve for preliminary buttons would be highly useful if it were not for a much simpler method, in which calculations are made by the ordinary balance and no handling of weights is required (ENG. & MIN. JOURN., Oct. 1, 1910, p. 647. "Analytical Methods in the Cananea Laboratory," by F. G. Hawley.) The impression that the niter method is unsatisfactory in charges requiring more than 20 grams of niter is not necessarily true. A highly oxidizing charge which is sufficiently dilute to prevent too violent reaction between the sulphides and the niter will give good results irrespective of the amount of niter used, providing the charge can be fused with sufficient rapidity without overheating.

The following charge, when properly handled, may be depended upon for good results with high sulphide ores, and it is rare that a greater ratio of flux to sulphide is required: Ore, ½ a.t.; Na_2CO_3, ½ a.t.; PbO, 3½ a.t.; borax glass, ⅕ a.t.; silica, ⅙ a.t.; niter, as required.

For the best results it is necessary to introduce the charge into a hot furnace and bring rapidly to fusion, i.e., in from seven to 10 min., with a total time required in furnace of about 30 min. The more sulphide present, the higher the initial temperature required. It is essential that the difference between bringing a charge rapidly to fusion, and carrying it through at an excessively high temperature, be appreciated. If the assay is overheated, low silver results will be obtained. The usual niter charge gives a slag with low surface tension and the oxidized products are not gaseous; therefore, the charge boils little and a rather poor circulation of reduced lead is obtained. For this reason we find it desirable to produce a 25-gram lead button. The preliminary assay for the above charge is: Ore, $\frac{1}{10}$ a.t.; Na_2CO_3, ⅓ a.t.; PbO, 2 a.t., observing the above conditions of fusion. The calculation will be $\frac{W \times 5 - 25}{4.25} = X$ grams of niter.

To uses Hawley's method, we have this consideration: ½ a.t. equals 14.583 grams, which, divided by the oxidizing



NITER BALANCE

power of niter, 4.25 grams gives 3.43 grams, which is the amount of ore to use for preliminary assay. Make a special weight for this purpose. The calculation then becomes $\frac{W \times 4.25 - 25}{4.25} = X$ grams of niter, which, reduced, equals $W - 5.88$. If, then, we place the preliminary lead button on the left-hand scale pan and suspend a subtracting weight of 5.88 grams from the hook on the opposite side of beam and balance with niter, we shall obtain the requisite amount of this reagent. The statement that niter is less oxidizing in an acid slag is scarcely correct. It is the litharge which loses its efficiency by forming silicates and borates.

E. J. HALL.

New York, Jan. 30, 1912.

Use for Vanadium Bearing Iron Sands

I have established the presence of vanadium in the iron sands of Patea (*cf. Daily Consular and Trade Reports*, No. 187, Aug. 11, 1911) to the extent of 0.15 to 18%, and wish to know whether this percentage of that metal can be turned to commercial account in the United States, either for extraction of vanadium, or as a component in the making of steel. Any reply which is received through the Discussion column of the JOURNAL will be greatly appreciated.

I would ask those who consider these prospective uses to think both of its importation as raw material, or as partly manufactured steel on which the duty is 15c. per cwt., and also whether the completion of the Panama Canal will make any difference in the possibility of the transport of this material from New Zealand to the extreme Eastern seaport points of the United States.

A. D. BANFEILD.

Westport, N. Z., Dec. 27, 1911.

Where Should the Primer Go?

In the interesting article on explosives in the JOURNAL of Feb. 3, under the head of position of primer, Mr. Anderson, engineer with the technical division of the Du Pont company, states: "With . . . . the gelatin dynamites, there is no doubt but that the proper position for the primer is near the bottom of the hole, and the best results will be obtained by pointing the closed end of the cap toward the center of the charge . . . . because the explosion of the powder starts at the detonator and the force is greatest at that point; the bottom of the hole being the the strongest, it is the part that requires the greatest explosive force."

The du Pont company has just issued a booklet entitled "High Explosives," on p. 43 of which I find this statement: "The effect of a detonator on a charge of high explosive in a bore hole is not infinite, but decreases with distance. It is, therefore, easy to understand the necessity for using detonators sufficiently strong for the effect of the detonator itself to extend throughout the charge. It might be understood from this that the detonator should be located in the center of the charge, and this would be correct, had not numerous tests shown that the greatest effect of the detonator is straight away from its loaded end in a line with its long axis." And on p. 57 this booklet continues: "If the primer is made with fuse and blasting cap, it should be put into the bore hole last; if with an electric fuse, last or next to last."

I grant Mr. Anderson's argument that a stick of powder with a cap in it will do more execution than a similar stick without a cap, and I admit that the inference would be that the bottom of the hole, where the burden is greatest, is the place for the primer, but what about the "num-

erous tests" of the du Pont company, which have shown that these natural inferences are not always correct? I should appreciate it if Mr. Anderson would elucidate this apparent conflict of authorities within the house of du Pont.

PERCY E. BARBOUR.

Candor, N. C., Feb. 6, 1912.

The Experiment Station Bill

The text of the Martin bill for the experiment stations, as published in the JOURNAL of Feb. 10, 1912, provides that a mining experiment station may be established in each of the states and territories where precious metals occur in commercial quantities. What are commercial quantities? Can Maryland, with a 1911 production of 87 oz. of silver and 1 oz. of gold, have an experiment station, while rock-ribbed Republican Vermont has none to investigate its granite and building stones? Shall Virginia, with a 1910 and 1911 united production of 260 oz. gold and 245 oz. silver, have an experiment station, while Maine gets none to search its pyrite deposits for precious metals? Or, if we exclude Maryland and Virginia from participation in the pie, shall we begin with Illinois, credited with a two-year production of 289 oz. of gold and 6748 oz. of silver? Or shall we let New York, with its Golconda of Adirondack "green gold," go stationless? Here is where the station is really needed. Any assayer can find the Western gold. Patient experiment is needed to find that of the Adirondacks. And New York contains over one-twentieth of the voters.

And what does "$5000 in establishing, equipping and maintaining each of said experiment stations" mean? Is this per annum, per century, or, like Carnegie libraries, is this to start the thing going, and after that the receipts take care of the expenses, except for the salaries of the geologist and the chemist? These are interesting points. What is the use of establishing experiment stations anyway, if the lucky town can't have a public building, and what sort of a public building can be built for $5000, if the furnishings of a chemical laboratory must also be paid for out of this amount.

Why does "an expert geologist" receive $3000 per annum under this bill, while an "expert and competent chemist" gets only $2000? Base favoritism, probably inspired by the Geological Survey! Is not the chemist worthy of his hire? And why should the geologist be expected to travel in his leisure time, and not the chemist? Can't the geologist rest content with his extra $1000 and not also have the benefit of an expense account over the poor but perspiring chemist? Rampant injustice! Here goes for a course in geology.

CHEMIST.

Perth Amboy, N. J., Feb. 12, 1912.

Geology Applied to Mining

When reading articles on applied geology, such as "Geology Applied to Mining," by Linforth and Milburn, published in the JOURNAL of Apr. 1, 1911, and "Problems on the Dip" and "Problems on the Strike," by Josiah Bond in the issues of Sept. 2, and Nov. 25, 1911, I am always reminded of some of the geological dissertations that I have found in reports and descriptions of mining properties that were offered for sale. I do not refer to the reports made by competent geologists or mining engineers, but to those made by men who are often good miners and know a mine or prospect when they see it, but who are not geologists. Attention is often first drawn to excellent prospects by just such reports.

I have in mind one such report that gave a detailed description of the mine, the work that had been done on it, with maps showing where samples had been taken and assayed. Every statement seemed to have been honestly and intelligently made. The report aroused interest in the prospect and created a favorable impression of the author until the paragraphs on geology were read. There the author "spread himself" and went at length into the origin of ores in general and of this deposit in particular. There was not a single statement founded on facts; only the author's suppositions. The geology was obviously mentioned for effect. Fortunately in this case the rest of the report was so sound that the prospect was examined and proved to be as represented.

This is not an exceptional case, but the rule, as most engineers who have dealt with such reports can testify. And it is by no means the case that such flights of fancy are confined to reports written by men who do not even claim to be mining engineers. Some of the most elaborate geological dissertations that I have ever read were written by men who were excellent engineers, but whose experience had not yet taught them to leave geological matters to the geologists.

This tendency to delve into inconsequential geological theorizing seems to come from the unwarranted assumption that there is a recognized law in the relation of the richness and extent of an ore deposit to the rocks in which it occurs. The tendency has been further fostered by the great number of scientific papers that have been published on the origin of ore deposits. It is a very human trait to inquire into the unknown and formulate hypotheses as to the cause and origin of natural phenomena.

The study of the origin of ore deposits still belongs to the realm of pure science, and to trained and experienced geologists. The hypotheses that have been formulated as to the origin of ores are of interest to the mining geologist, but rarely of value to the mine owner. It is better to leave all such work to the men who make it a life study.

The great objection to this tendency to theorize is that the useful and valuable geological facts are overlooked. The mining engineer and mine owner are interested in the ore as it now is, not in how it got there. It does not matter much what the rock is, in which the ore is found, nor its age, but the condition of the rock is of importance. The effects of faults, fissures, slips, joints, interruption in the continuity of ore, class of rock and its succession by another class, are of great importance and their significance is often unappreciated.

How such geological data are applied to useful purposes in tracing a lost or faulted vein is described by Linforth and Milburn, while Mr. Bond's articles describe how costly it may sometimes be to neglect the geological evidences of the effects of dislocation. In some instances, where the orebody is much broken and faulted, the geological maps may be of as much value as the assay plans.

The value of this sort of geological work is now rapidly becoming more appreciated and as the methods of applying the data become generally known we may expect to find the geological maps taking their proper place second only in importance to the assay plans. It is also to be hoped that a careful description of slips and faults and other such structural geological features that may have an influence on the system of mining the ore, will usurp the place of that worn-out phrase, "favorable formation," and flights of geological fancy in reports of the class hereinbefore mentioned.

J. A. HERDY.

Chicago, Ill., Feb. 7, 1912.

Literary Taste of Miners

I was recently reminded of a statement seen several years ago in the *Bookman*, remarking that "The Connecticut Yankee in King Arthur's Court" was the poorest of Mark Twain's books. In two of the libraries seen recently in this part of the country I have noted that Mark Twain's works were among the most worn, and the "Yankee" was the most used up of the set, apparently by use and not abuse. Is this indicative of poor taste in the miners or is there a virility in this book not perhaps appreciated in the *Bookman*?

K. T. WHEELER.

Bisbee, Ariz., Feb. 3, 1912.

Caucasus Copper Co.

I see that S. F. Shaw, in his data concerning the mines of the world (ENG. AND MIN. JOURN., Jan. 13, 1912), places the Caucasus Copper Co. in Siberia. As its name implies, it is situated in the Caucasus district of the Russian empire.

V. C. SVIMONOFF.

Pittsburg, Penn., Jan. 23, 1912.

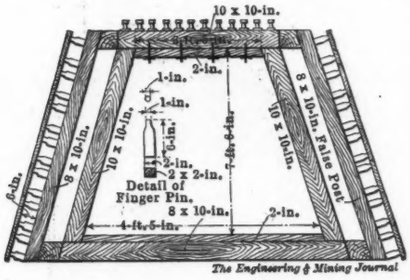
Details of Practical Mining

Accounts of Useful Ways of Doing Many Things in the Day's Work

This department is designed to treat in a brief way of details of everyday practice. Many readers are doing interesting things in mining and milling that other readers like to know about. The thought that there is nothing new in them should not be a deterrent to telling about them. Something that is an old story in one district may be quite unknown in another. Our draftsmen can develop any kind of a pencil sketch that is intelligible. A blueprint answers all the purposes of the engraver. Contributions are solicited.

Finger-pin Timbering in Swelling Ground

The finger-pin method of protecting drift sets in swelling ground was devised on the Comstock lode, and has been in use there several years. In it, as can be seen in the accompanying drawing, the lagging is held back against the



BRIDGE SETS WITH LAGGING OVER FINGER PINS

swelling ground by means of finger pins, as they are called, pieces of fir 2 by 2 in. in section, about six inches long and sharpened at their small end to a diameter of about an inch. Two of these pins are put in at each end of a plank, with the larger end against the post as the pressure on that end is less per square inch than that on the small end of the pin. The pin therefore is forced through the lagging as the ground swells, and the lagging is impaled upon the pins. In this way the posts are protected. As soon as the ground has moved in enough so that the lagging is almost against the posts, the ground is eased off, pieces of 2-in. plank are put in to cover the holes, and again the planks are impaled on the pins.

The drawback to this simple sprag-pin drift set is that the head timberman and shift-bosses fail to keep close watch of the sets, and before it is discovered the ground is liable to have moved in to the post and broken the timbers. To guard against this the finger-pin method was combined at the Goldfield Consolidated mines with the old method of false sets as is shown in regard to the side lagging in the accompanying drawing. Then, in case the sets are forgotten only the timbers of the false set will be broken.

It is impossible to use these finger pins in supporting the top lagging as owing to unequal weight jack-knifing is sure to occur. Consequently, the procedure is to carry the roof lagging on false caps resting on blocks over the tops of the posts, but where old mine rails are obtainable, they probably make the best lagging for the roof in swelling ground. The rails are used with the bottoms against the caps. Then the ground as it swells will force itself down between the rails and hang down in festoons until it drops off of its own weight. This is the method used at the Copper Queen mines in supporting the roof of drifts in badly swelling ground. Rails are also used for side lagging in the worst ground.

In case that the ground in the bottom of a drift swells, the best thing to do is to keep the bottom covered with several inches of standing water or sand. This keeps the air away from the ground and prevents further oxidation of the decomposing minerals, generally the feldspar.

The oxidation of certain minerals in the rock is, in general, the cause of swelling ground, although in some cases it does seem as though the swelling, especially in talcy ground, is due to real flowage of the rock itself. In holding swelling ground, therefore, the plan is to ease the timbers as little as possible each time so as to try to get a considerable layer of thoroughly oxidized ground exposed to the air so that further oxidation behind the outer layer will be prevented as much as possible.

The Oliver Iron Mining Co.'s ore crusher, at Escanaba, Mich., crushed 200,000 tons of ore in the season of 1911. This is a record amount for the company, although the plant can handle 500,000 tons in a season if necessary. Concentration of crushing operations for the Oliver company's Menominee Range mines is reported to have cheapened the crushing cost materially.

Thawing Frozen Water Pipes

The following method of thawing 150 ft. of ¾-in. pipe is given by J. E. Bates in *Power*. The only current available was that of a railway system supplied from rotary converters at 650 volts. The substation was 14 miles from the main power house, but by shutting down the converters and thawing when few or no cars were running a voltage of 500 was obtained. After rigging up a barrel as a water rheostat one lead was attached to a faucet at the extreme end of the ¾-in. pipe line and the other to a valve on the water main and the upper terminal was lowered into the barrel until the ammeter showed 200 amperes; the voltage dropped to about 200. It took about 1½ hours to thaw out the pipe.

At another time the supply pipe to a dwelling house froze; it was about 50 ft. long and ¾-in. pipe. There was a one-wire feed to the house from the trolley circuit which burned five lamps in series; the return was grounded on the water pipe in the house. It was not known how the current got back to the station; the water mains were all of wood. The trolley voltage was 650, but with the five lamps burning only 600 volts were obtained showing a drop of 50 volts. On the night the pipe froze, the feed wire was connected directly to the faucet of the water pipe and left on all night, leaving the faucet partly open.

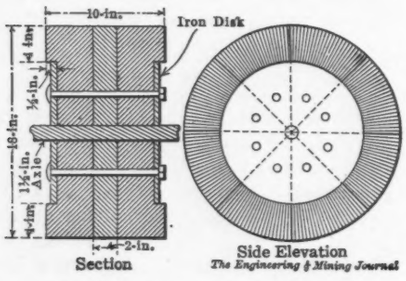
In the morning the water was running. How much current it took was not determined, but it could not have been much because it was not enough to even warm up a No. 14 copper wire.

Success in thawing pipes by electricity, states *Coal Age* in describing the method, will depend in any particular case on at least two essential conditions; namely, (1) sufficient electric current at high amperage and relatively low voltage, depending on the size, length and conductivity of the pipe, which can only be definitely determined by experiment; (2) a sufficient insulation of the pipe line throughout the length of the frozen section to confine the electric current to the pipe without undue loss of power.

The principle is that the resistance develops heat and melts the ice. For alternating currents a special transformer is generally required, as the ordinary type will hardly be capable of giving the required voltage and amperage. This must be ordered to suit the conditions, which should be submitted in detail to a competent electrician.

Rope Idlers for Inclined Shafts

In the conglomerate shafts of the Calumet & Hecla company where, owing to the necessity of not cutting into the foot nor the hanging wall, the shaft must follow the lode in all its changes of dip, the rope idlers or rollers are subjected to severe wear, and some of them have to be replaced once per shift, while the average life of an idler in the whole shaft is not over a week. The idlers are therefore cheaply and simply made. They are maple logs turned down to a diameter of 16 in. and a face of 24 in., in which three grooves are turned along which the cable may run as the idler is shifted in the shaft. Through the center of the idler a 1½-in. hole is bored for the axle. Formerly an iron pipe was inserted in the idlers for a thimble and the idler revolved on a fixed axle. This arrangement is cheaper and good enough for



IDLER FOR SKIP ROPE IN SHAFTS

shallow shafts where the hoisting speed is not great, but there is too much friction to use these idlers at high rope-speeds as it is impossible to grease them properly.

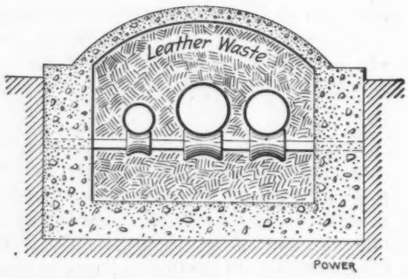
The idlers now generally used have a fixed axle that rests in two bearings on the idler frame which is wedged in place in the shaft between the cedar ties of the skip tracks. These frames are set in the shaft so that the rope passes through the right-hand groove of one idler, the center groove of the next and the left-hand groove of the next. By changing the idlers from one frame to another they may be completely worn out.

This type of idler is used in the amygdaloid mines of the district, except at the shafts of the Osceola Consolidated, where a built-up idler is used. This idler, as the amygdaloid shafts are sunk at a regular dip, does not have to be made so wide to insure the rope staying on the idler, while as the wear is not so great as in the conglomerate shafts, the idler part is built up of segments so that the wear will come end-on instead of sidewise with the fiber of the wood. These built-up idlers are 18 in. diameter and 10 in. wide. There are three layers of octant segments held together by flanges and bolts through the apex of each, as shown in the accompanying sketch. The outer segments are sawed from 4x6-in. maple or beech planks, being cut so that the grain runs approximately lengthwise, while the inside segment, the one that takes the wear, is sawed from a 2x6-in. plank of the same material. It is, therefore, possible to replace the segments without throwing away the whole idler when only a few of the segments in a layer are worn. The outer segments are made with a shoulder ½ in. deep turned in them to receive the flanges so that the bolts that run through the idler will not extend beyond the sides to wear and cut the rope in case it should slip off the idler.

These idlers have been in use several years, they last much longer than do the other types, and as they are lighter, they get up to speed when the rope comes on them quicker than do the others. In the conglomerate mines they cannot be used, because the wear is so great that it does not pay to try to increase the life of the idlers by complicating the design.

A Concrete Trench for Pipes

The trench shown in the accompanying illustration was originally designed for use underground for the purpose of carrying steam pipes without excessive loss of steam through radiation, and to prevent, so far as possible, heating of the drifts through which the pipes pass. The body of the trench is three or four inches thick. The steam pipes are carried on rollers mounted on horizontal cross rods imbedded in the concrete.



SECTION OF PIPE TRENCH

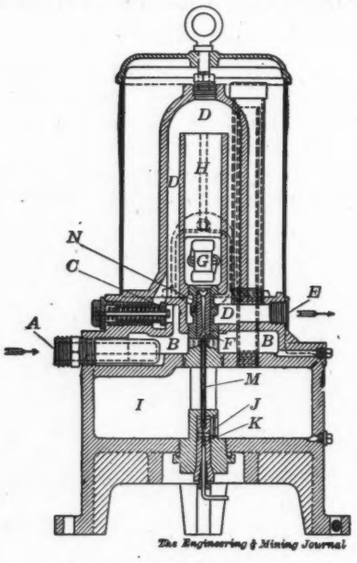
After the pipes are laid, leather waste, sand or other suitable non-conductor of heat is used as a covering. The trench is covered with concrete one inch thick so that the top can readily be broken into when it is necessary to get to the pipes.

Similar trenches can be used to advantage at the surface for protecting water pipes from freezing in cold weather. There are advantages in not burying water pipes at the surface of a mine; it is frequently necessary to reach the pipes, which cannot be so readily done if they are buried deep enough to be below the frost line.

Reheating Air for Drills

A simple portable air reheater intended for use directly at the drill is shown in the accompanying illustration. This air reheater is designed automatically to maintain any predetermined temperature in a compressed-air line, thus expanding the volume, by means of continuous internal combustion of gasoline, benzine or kerosene.

The advantages to be gained and the saving to be made by reheating compressed air may be summarized as follows:—Compressed air for use in rock drills and other air tools may be heated to any desired temperature; the only limit is that temperature that will destroy lubrication. Modern practice establishes this temperature under superheated steam conditions between 500° F. and 600° F. In air tools or air engines, however, the temperature of the air cylinder is considerably less than the tempera-



STERLING AIR HEATER

ture of the air used, due to the absorption of heat by the rapidly expanding exhaust air. By using reheated air in rock drills a much greater ratio of expansion is possible before the freezing temperature is reached, consequently in addition to the saving of air consumed, all freezing troubles are eliminated.

The reheater is, according to *Engineering Contracting*, set in the air line near the machine and automatically maintains any desired temperature, as its operation is controlled by the flow of air. Combustion can only begin when the air passes through the reheater and ceases when the throttle valve of the tool is closed. The machine is always ready for immediate operation in warm or cold weather and the increased temperature desired is absolutely under the control of the operator by simply turning one valve.

The air is heated by means of continuous ignition of vaporized liquid fuel. It operates equally well on gasoline, kerosene, or any high-grade distillate of crude oil. Perfect combustion is maintained under all conditions, because the combustible mixture of vaporized fuel oil when burned in the combustion chamber is completely surrounded by an abundance of oxygen. Consequently, the heated air in leaving the reheater is absolutely clean and free from any smoke or carbon. The continuous ignition is effected by means of a small electric resistance coil using either 110 or 220 volt alternating or direct current, or, in the absence of an electric current, the ignition is maintained by means of a hot tube.

When the machine is started, air enters the space *B*, of the Sterling reheater shown in the accompanying sketch, and about 98% passes through valve *C* into space *D*. The rest of the air passes through the inspirator opening *F* through the mixing tube *N* and forms a combustible mixture with the fuel oil drawn from tube *M* at the point *F* when the needle valve is open about a quarter of a turn, thus admitting fuel oil through the screen *J* through tube *M* to the point of nozzle at *F*. This combustible mixture is ignited by contact with coil *G* and is burned in the combustion zone at a high temperature; then mixing with the air in *D* and uniformly heating the entire volume to the desired temperature as controlled by the fuel needle valve *K*. The air pressure in *B* and *I*, being maintained the same in these two compartments by means of a balance pipe, as shown, is a fraction of a pound more than in *D*, due to the floating deflector *C*. This difference in pressure raises the fuel oil through *M* to the nozzle. The instant the air passes through the heater, combustion begins and when the tool is shut off combustion ceases. The needle valve *K* is the only adjustable part of the heater. When this valve is once set, the action of the heater is uniform and a constant temperature is maintained by it. The only manual attention required being the renewal of the fuel supply. Approximately 2½ gal. of gasoline or kerosene will heat 100 cu.ft. of free air per min. from 50° to 350° for 10 hours continuous run.

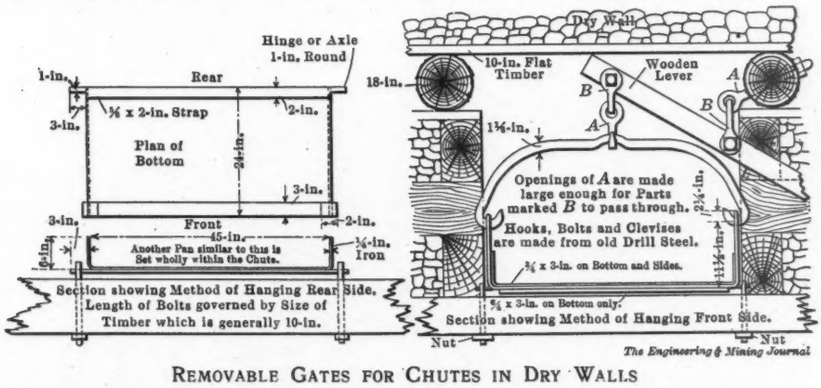
A Mine Chute Gate

By Claude T. Rice

The accompanying sketch shows the gate used in the dry-wall chutes or millholes at the Baltic mine in the Lake Superior copper country. The bolts are put through augur holes in the timbers so that by unscrewing the nut on the ends of the bolts the eye-bolts can be taken out. By taking out the eye-bolts in the front timber or lip piece, that is built into the walls at the millholes, the apron gate can be taken off. Then by taking out the bolts *A* from the clevises *B* that fasten the levers to the wall-piece eye-bolts, the entire gate can be transferred without much trouble to another millhole to be returned again when mining comes back to that part of the stope. The apron gate is always taken off when the millohole is converted into a temporary manway. The lever on the gate is a cedar pole about 10 ft. long bored at the proper points to receive the clevis pins. The gate is held shut by bringing the end of the sweep or lever behind a piece of drill steel or pipe that projects from the dry wall near its bottom. While the car is being loaded, the gate rests on the body of the car.

It was formerly the custom to put a flat piece of sheet iron hinged to the gate in the bottom of the millhole so as to protect the lip timber from wear. This was found unnecessary as in case the lip piece wore so that it would no longer take the strain of the gate, straps could be fastened to the piece of timber in the side of the chute from which the dry walls on the side spring, and the gate secured to these straps. So the pan, as the flat piece is called, is no longer put in the bottom of the millholes at the Baltic and Champion mines. In case the men, in building the chute, make it too wide at its mouth, the fault is remedied by spiking some 2-in. planks to the side timbers of the millhole. Sometimes trouble is experienced from fine rock coming out of the mouth of the millholes when they are about empty and the men are loading into them. This is remedied by building up a temporary grating of old plank and dull drills crisscross around the gate both along the sides as well as in front.

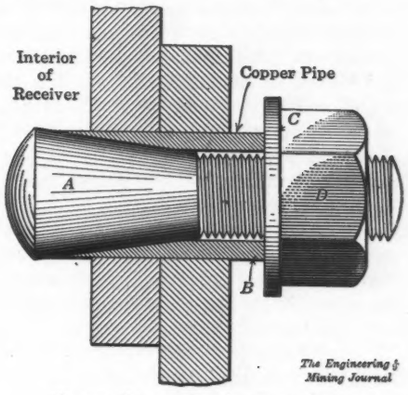
The great advantage of this gate is that it is so easily dismantled. It is simple, effective and inexpensive when its life is considered. The eye-bolts and the pins can be made to serve repeatedly as they always can be taken out of the timbers without much difficulty. The drawing is not intended especially to show the manner of making the mouths of the dry-wall millholes, as this is not the standard form, although sometimes used; so much timber is not typical of the mouths of the millholes.



Removable Gates for Chutes in Dry Walls

Stopping Leaks in Air Receivers

A convenient method of stopping leaks around a loose rivet in air receivers or steel water tanks, or even for emergency repair work on boilers, and one which can be made entirely from the outside, is to use a taper bolt with copper sleeve, as illustrated in the accompanying sketch.



Taper Bolt for Stoping Leaks

The head of the faulty rivet is cut off, and the rivet knocked out of the hole or else the rivet may be drilled out. A taper bolt *A*, large enough to pass through the hole, and threaded up to 1½ in. of the large end is inserted in the rivet hole and a piece of copper pipe *B*, of the same internal diameter as the diameter of the bolt, is lipped over the threaded portion of the taper bolt; it should project ¼ to ⅜ in. on each side of the plates. A washer *C* and nut *D* are then put on and the nut screwed up with a long-handle wrench. The bolt can be used for withstanding pressures up to 200 lb. per sq. in. with safety.

The bolt may be used for repairing other small leaks such as may occur in pump columns by drilling out a hole at the point where the leakage occurs. A variety of uses for such a bolt will be suggested by the sketch.

Hints on Buying Pumps

By John S. Leese*

When a prospective purchaser of new equipment of any description is making inquiries of the manufacturers, if he would give a terse account of what he wants he would save much time and lengthy correspondence on the subject of the inquiry. This is not all he would do, however. When the manufacturer knows what the conditions are, under which his machine is expected to operate, he will, by virtue of his long and specialized experience in his own line, be able to supply the most suitable equipment at a reasonable price. The neglect of inquirers to state specifically what they want and what they want it for, is the cause of endless uncertainty and confusion and may result in the undeserved donation of a bad name in a particular place, where a piece of machinery has been installed without the maker having had the opportunity of obtaining full cognizance of the requirements of that case.

If one were considering the purchase of a heavy draught horse, he would, in writing to his dealer, give some information as to the loads and class of work the animal is intended to be put to. He would not write and say, "I want a horse," simply. Why this "horse sense" does not apply more generally to purchasers of mechanical equipment than it does, is a matter of surprise to those who have the doubtfully pleasant task of answering inquiries in the machinery market. I know from experience what a considerable proportion of inquiries come into an engineer's office which are of the "I want a horse" variety, and I am therefore prompted to delineate, in the present article, the most important points to be considered in the selection of a pump.

In the contemplation of the purchase of a pump the following particulars should be stipulated and supplied to each manufacturer along with the letter of inquiry:

(1) The service for which the pump is to be used.

(2) Whether the liquid to be pumped will be hot or cold.

(3) If the liquid is hot, will it be of such a temperature as to evaporate upon the removal of pressure?

(4) If the last answer is in the affirmative, state whether means are available by which the liquid may be arranged to flow by gravity into the pump chamber to submerge the valves.

(5) Whether the liquid to be pumped will be clear or gritty, salt or fresh water, acid or non-corrosive.

(6) The lift through which the liquid is to be raised by the pump suction.

(7) The approximate length, cross-section and conformation of the suction pipe.

(8) The number of tees and elbows in the suction pipe line, and their dimensions.

(9) The source from which the supply of liquid is to be taken by the pump.

(10) What capacity the pump is required for, in gallons of water per hour or per working day.

(11) The head and height against which the liquid is to be forced.

(12) The nature of the head.

(13) The conformation and size of the delivery pipe.

(14) The steam pressure available at the steam end of a steam-driven pump.

(15) In the case of a new installation, give the distance from the boiler to the pump, and the boiler pressure under which the pump is to operate.

(16) The nature of exhaust provided for the steam end of the pump; whether it is to the atmosphere, to a condenser, or against a back pressure.

(17) If the steam is to exhaust into a condenser or against a back pressure, state what the pressure is.

In addition to the important particulars enumerated above there are other requirements and details which it will seldom trouble an intelligent brain to discover. Everything which can be of assistance to the manufacturer should be mentioned. The fulfillment of this condition will tend to go far toward satisfactory operation and a reasonable invoice.

*9 South Parade, Deansgate, Manchester, England.

In the Parral camp in Mexico, a fair price for contract work on exploration tunnels for the first 200 m. is 26 pesos per meter, powder and steel being furnished by the company. About a meter per day per shift can be advanced in ordinary rock.

Turning a Large Sheave

By Frederick MacCoy*

Recently at the hoisting shaft of the Esperanza mine at El Oro, Mexico, one of the sheave-wheels that carries a 5-in. flat cable broke, and as it would require about two months to secure a new one from the United States, it was decided to build one locally.

A local foundry was found that would undertake the work of casting the wheel which was to have wrought-iron spokes, but cast-iron hub and rim. As the mine did not have a lathe large enough to finish the hub and rim, the work was done in the following manner: The wheel was bolted down on the floor at one side of a radial-arm drill press. A cast-iron cylinder was then turned down slightly smaller than the hub as cast, and this cylinder was slotted to hold a lathe-cutting tool, which cutter was held in place with a setscrew. The cylinder was tapped out to hold a piece of tool steel that in turn was fitted into the regular drill socket. The arm of the drill press was then run out over the hub, accurately centered and clamped. Then the cylinder carrying the cutter was fed slowly down, boring out the hub to the required diameter as it revolved.

Turning a Large Sheave in a Small Lathe

To turn the rim was the next job, so the sheave was mounted on a piece of shafting as shown in the accompanying illustration; the shafting mounted on horses and a pulley mounted on the shaft. The pulley received its power from the lathe and the tool truck on the lathe was reversed so as to handle the cutter against the sheave face. The work was done entirely by native workmen outside of the molding of the wheel at the foundry.

*Chief engineer, Esperanza Mining Co., El Oro, Mexico.

Hoisting Engine Repair Job

At a coal mine in Pennsylvania a 32- by 48-in. first-motion hoisting engine was injured by water entering the cylinders with the steam. This water had accumulated in the pipe line from condensation. The entrance of this water into the cylinders resulted in cracking the engine frames on the under sides of the throat, next to the flange where it was bolted to the cylinder. The engine bed was also broken on one side at the pillow block, either one of the fractures being so severe as to render the engine useless until a new frame could be obtained or repairs made.

The repairs were made as follows and are of special interest as being examples of the emergency casting work that

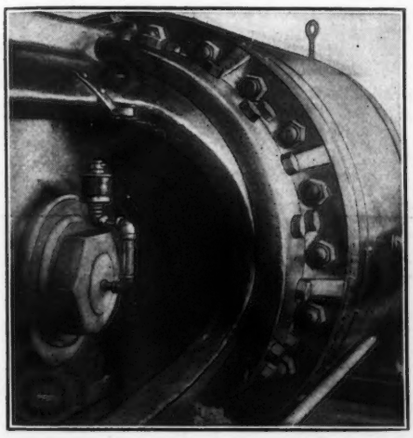


FIG. 1. CASTING FITTED TO FRAME OF ENGINE

Henry M. Lane has been describing in articles on "First Aid to Mining Machinery." A heavy casting was made to fit on the outside of the engine frame and was flanged to the same size as the frame and the cylinder. Long stud-bolts were used instead of the engine studs, and clearance holes were drilled in the casting to match those in the engine frame. Another set of holes was drilled and tapped in the frame and corresponding holes drilled in the casting. Cap-bolts were then screwed tightly in place. The nuts on the stud-bolts were then screwed up tight. Ribs were made on the casting to strengthen it. A 1½-in. rod was screwed into the base of the engine frame on each side of the cylinder and also pressed through the foot at the head end of the cylinder. These rods were made tight by nuts, as shown in Fig. 1, and the whole served to prevent the cylinder from pulling away from the frame; both cylinders were treated in the same manner.

Securing the pillow block to the frame was a more difficult job, but it was accomplished by making a new cup for the bearing, having a shoulder cast on the inner end. A special casting was made to butt against this shoulder and to extend out on top of the engine frame, as shown in Fig. 2. The two shoulders were held together by five 1½-in. bolts; the angle casting was secured to the engine bed by eleven 1-in. cap-screws.

On each side of the frame two angle irons were secured by 1-in. bolts and the angle end of each was drilled for a 1¼-in. stay-rod; the inner end of each was screwed into the projecting end of the pillow block of the crank disk. The other end of each rod passed through the hole in the angle iron and was made tight by a nut, as shown.

To make the job more secure, a small casting was made to fit against the outer end of the frame and pillow block. Two holes were drilled in it for two 2-in. rods which were slotted for a key. The other end of each rod was fastened, drilled and secured to the engine frame by a bolt which extended through the engine frame and both eyes of the two bolts, as shown just back of the crank disk in Fig. 2. The bolts drew the frame tight at the bottom and prevented end-play at that point.

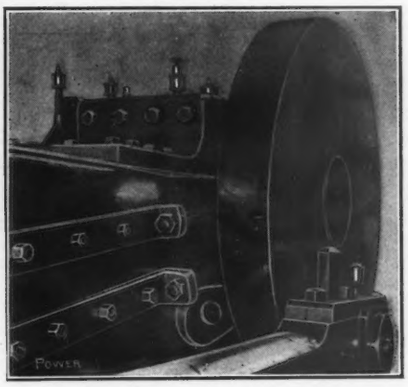


FIG. 2. SPECIAL PILLOW BLOCK CAP FITTED TO FRAME

This completed the job, and the engine has been in use during working hours for a period of about three years, which speaks well for the manner in which the work was done.

Reproducing Mounted Plans

The reproduction of some mounted plans was found to offer considerable difficulties by the West Australia District Survey[1]. Photo-lithography was tried, but it was found that a lithograph required much retouching before it could be used, while sun-printing was out of the question because of the thickness of the paper.

Prints were finally made by placing a sheet of bromide paper in a printing frame, placing the drawing face down over it, and printing by electric light. In this way a paper negative was obtained. The paper used was "Platino-Argentic," and for the subsequent positive, "Nepera gas-light." The light was about 100 c.p., and the exposure 15 sec. for the negative, and 6 min. for the positive. Ferrous oxalate and hydroquinone developers gave the best results.

It was found that a first-class contact between paper and drawing was essential, and for this reason a printing frame fitted with a rubber blanket was used. The frame is provided with hinged flaps which are screwed down on to the edges of the blanket, and the air between the blanket and glass is then exhausted.

[1]Survey Journ., Sept. 1, 1911.

Ejectors for Mine Drainage

An interesting application of an ejector for draining drifts in the deep-lead mines of Victoria was recently proposed in the *Australian Mining Standard.* In the deep-lead mines little trouble is experienced from water when driving up the lead as the water flows down the slope to the shaft. In driving down the lead the accumulation of water at the face is a source of delay and annoyance.

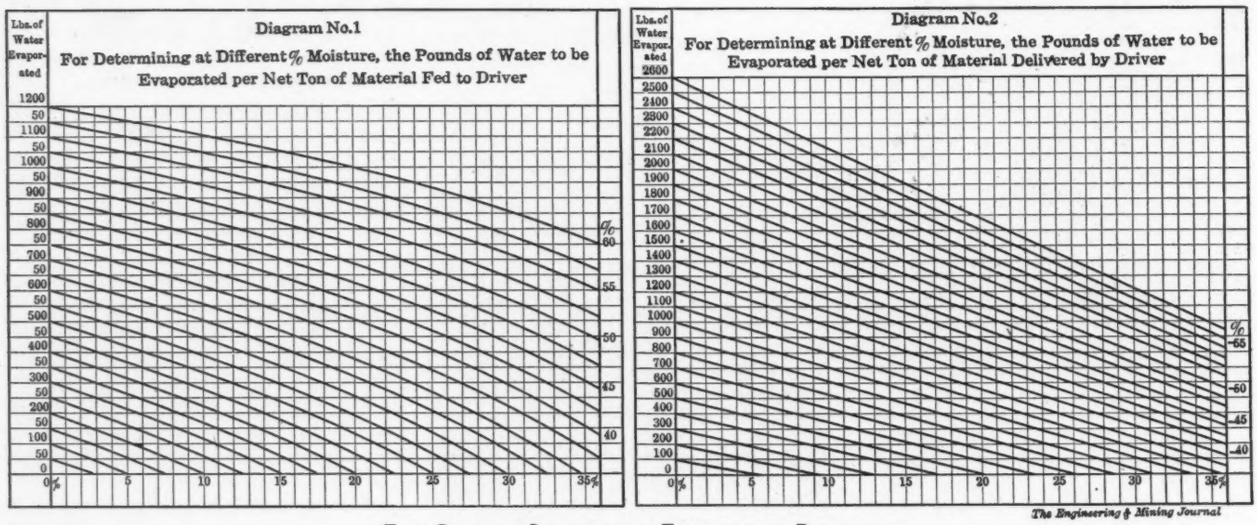
The drifts are usually long and circuitous, so that the installation of a pump and pipe lines is an item of large expense. Baling or removing the water in trucks is convenient where the flow is light, but unsatisfactory if the flow be large.

The proposed method of draining is to utilize the water of the lead itself for drainage. The sedimentaries overlying the lead are usually water bearing, and test holes show that a pressure of 20 lb. is obtained by boring up into this stratum and casing the hole. It is proposed to use 2-in. casing and connect the stream issuing therefrom to operate an ejector, the suction end of which would be placed in the water that accumulates at the face of the drift. This water would be driven up the drift to a sump at the shaft by the ejector. It is thought that such a method would not only effectually and cheaply drain the drift, but would also obviate a burst of water from the overlying water-bearing bed.

This method of draining is novel, insofar as it makes use of the water contained in the upper strata, but it is doubtful if there are many mines outside of the deep leads of Victoria where it could be applied. The ejector has been used in draining mines in the United States, but only with high heads and comparatively low lifts. When applied under such conditions the pressure water can lift up to 11 or 12 times its volume of mine water, depending, of course, upon the ratio of pressure to lift. What the result would be in attempting to use so low a pressure as 20 lb. can only be determined from experience, but it would seem that the proposed method would necessarily be of limited application.

Graphic Solution of Evaporating Problems

Mining, smelting, and refining companies that use driers will find useful the accompanying curves prepared by the engineering staff of the Ruggles-Coles Engineering Co., of 50 Church Street, New York. The use of the curves will be made clear by taking a specific example. Referring to diagram No. 2, assume that it is desired to know the pounds of water to be evaporated per ton of ore delivered by the driver in reducing its moisture from 23 to 3%. Follow the heavy diagonal corresponding to 23 at the right of the curve across until it intersects the ordinate of the point 3. Then follow the horizontal line to the left and the result indicated is 520 lbs., the amount of water to be evaporated per net ton of ore delivered by the driver. In using diagram No. 1 for determining at different percentages of moisture the pounds of water to be evaporated per net ton of material *fed* to drier, the same method is used. It is evident that there is a considerable time saved by the use of these diagrams.


Lbs. of Water Evaporated
Diagram No. 1
For Determining at Different % Moisture, the Pounds of Water to be Evaporated per Net Ton of Material Fed to Driver
%
Lbs. of Water Evaporated
Diagram No. 2
For Determining at Different % Moisture, the Pounds of Water to be Evaporated per Net Ton of Material Delivered by Driver
%
The Engineering & Mining Journal

THE GRAPHIC SOLUTION OF EVAPORATING PROBLEMS

Firebrick at High Temperatures

It has been noticed that the volume of firebrick permanently increases after heating. According to J. M. Ogan[1] this is due to the formation of an impervious bleb structure in the glassy matrix formed by fusion.

The failure of firebrick at high temperature has also been investigated, by Bleininzer and Brown[2]. At a load of 50 lb. per sq.in., no firebrick can withstand a temperature of 1350° C., if the alkali equivalent be more than 0.225. Silica present in excess of Al_2O_3: 2 SiO_2 adds to the fluxing power of the alkali. Thus at 4.4 SiO_2: Al_2O_3, failure under the above conditions ensued at 0.17 R_2O. Experiments showed that most firebrick failed at about 125 lb. per sq.in., and that there is no relation between the crushing strength of a brick at ordinary temperatures and at 1300° Centigrade.

[1]Trans. American Ceramic Society, 1911, p. 602.
[2]Ibid, p. 210.

High Duty Gravity Stamps

Several months ago Peter Nissen read a paper before the Chemical, Metallurgical and Mining Society of South Africa, an abstract of which was published in the JOURNAL of Dec. 23, 1911, in which he gave the results of competitive trials between the Nissen single stamp and the modern Rand five-stamp batteries. Commenting upon this paper, H. Stadler, in the *South African Mining Journal* of Dec. 2, 1911, says in part:

In an appreciation of the undoubted merits of the Nissen stamp it is to be regretted that it has not been given a more thorough test. The summary of the "exhaustive" tests carried out at the City Deep, Ltd., by the Central Mining & Investment Corporation, Ltd., consists of but a few picked tests made under working conditions, which vary just enough to bring confusion into the figures, but not enough to allow a correct conclusion to be drawn as to the effect of these variations. My method of computing crushing efficiency, as practised during the last three years in the experimental work carried out on behalf of the Mines Trials Committee, has been proved to give highly satisfactory and reliable results, and it is, therefore, gratifying to me to have it confirmed by H. S. Ball,[1] who tells us that after careful examination "it was unanimously decided that this method would be applied to all crushing tests of the McGill University." In order to make the data of the summary of Mr. Nissen's paper more legible, the gradings have been replaced (in the accompanying table) by the one representative figure of their mechanical value, and the three factors determining the energy invested in the stamps by the one value of foot-pounds per second.

The mechanical values of the gradings are practically identical for both types of stamps and exactly correspond to those of the curve established for varying coarseness of battery mesh. This confirms the statement made in 1909[2] (referring to lighter stamps) that the gradings of screen pulps are not materially affected by varying working conditions of stamps, but are practically exclusively determined by the mesh aperture, and it shows that the principle also holds good for heavy stamps, at least within the range of the coarse meshes used in the tests. The horsepower consumption has been calculated from the value of the foot-pounds per second, with an allowance of 25% for loss in friction (in an old mill 30% is nearer the truth). By this method the power consumption works out lower, in all tests, for the ordinary stamps, while the table of the Central Mining & Investment Corporation, Ltd., with one exception, gives lower values for the Nissen stamp. Since the mechanical arrangements for lifting the stamps are practically the same in both types, the horsepower (as theoretically established) must be taken as giving more correct relative values than those obtainable by unreliable direct measurements. A possible error made by taking exactly the same height of drop for both cases would be in favor of the Nissen stamp, which, being heavier, might have its lift a little increased in consequence of a greater compression of the rock bed. Until we have been satisfied that all necessary precautions have been taken for exact tonnage measurements, the duties given in the table must be accepted with reserve. In truth they are in some cases not logically related to one another, nor to the conditions of the individual tests. The greatest drawbacks for such tonnage measurements are the continuous fluctuations in the proportion of "fines" contained in the feed.

The greater efficiency of the Nissen stamp, or the relative loss of energy in the old stamps, may be explained as follows:

[1]"The Economics of Tube Milling." Bull. Institution of Mining and Metallurgy, Aug. 30, 1911.

[1]Second report of the subcommittee, Mines Trials Committee.

(1) The roundish shape of the particles leaving a five-stamp battery proves that a certain amount of the reduction work is done by attrition and abrasion during the shifting and knocking about of the particles in the mortar box. In the one-unit Nissen stamp the particles are less subject to this action and less energy is lost by useless water churning.

(2) The radial arrangement of the screen allows an immediate rejection of the already finished product, leaving behind a clean material, which, since an ample percentage of its apparent volume is free interstices, is not subject to cushioning.

(3) The accumulated energy at the moment of the impact of a falling stamp is not only distributed over the surface area of the shoe, but it is also transmitted in depth. With a too thick or uneven rock bed, the amount of energy absorbed in packing the material, before crushing by compression can take place, may be so great that the crushing work done by direct impact becomes almost nil. The maintenance of an even surface of shoes and dies and the facility of weighting up the shoes as they wear are far-reaching advantages in the Nissen stamp, as they eliminate factors of inefficiency hitherto beyond our control.

(4) The blows of a one-unit Nissen stamp are bound to be harder and shorter, as the mass of the anvil formed by the thick and heavy bottom of the mortar box, placed in the center of the foundation, is certainly more solid and rigid than in the ordinary five-stamp mortar boxes, where rocking may take place. The vibrations due to the shocks being shorter, less energy is lost in shaking the building and surroundings.

The lower efficiency shown by the ordinary stamps is partly due to energy lost in deformation within the limits of elasticity, or permanent deformation before reaching the breaking point. To some extent, however, the loss of efficiency is only apparent, as the lower duty is to a certain extent balanced by a larger amount of crushing work performed in the very finest grades as a consequence of the attrition and abrasive action. By taking for the mechanical value of the —200 grade a standard value of 28 e.u. (energy units), the work done in producing ultra fine slime is not accounted for, but this is quite justified as, for Rand ore, grinding finer than to 200 mesh is mere waste of energy. From these premises we may make the deduction that the superiority of the Nissen stamp would be still more pronounced when crushing through finer mesh. The policy of ultra fine grinding by wholesale tube milling, just now in fashion in the metallurgical department controlling the "Rand Mines," has been, unfortunately, no inducement to them to extend their "exhaustive" tests in this direction, and the Nissen stamp has, therefore, not been given the chance of demonstrating its great possibilities as a fine grinder.

The departures are based on sound and theoretically correct principles, and the details of the mechanical arrangements are practical and handy. We have this confirmed by the best judges of new inventions in this connection—by the shiftmen, the men who have to work with it. The calculations of comparative working costs and capital expenditure may be open to criticism, but, compared with the other great advantages claimed and proved, the differences are too small to squabble about. Allowing for all uncertainties the Nissen stamp shows a decidedly higher efficiency than ordinary stamps.

The Heraeus Resistance Thermometer

By A. Schramm

The Heraeus thermometer is a new instrument for the measurement of temperatures, which is based on the increase in electric resistance of a metallic wire, as the metal is heated. In pure metals this increase is about 0.4% per deg. C., with alloys usually a little less. The "bulb" of the Heraeus thermometer consists of a thin quartz-glass tube, about which is wound a spiral of chemically pure platinum wire. This combination is covered with a thin layer of quartz glass, which protects the resistance coil against the influence of injurious gases and vapors, as well as against damage by breakage. Owing to the small coefficient of expansion of quartz glass the thermometer may be exposed to the greatest fluctuations of temperature.

An advantageous feature of the new thermometer is the standardizing of the resistance coil within 0.04%, so that in case of damage it may be replaced by another, without changing the measuring attachments. The standard instrument for industrial purposes has a resistance of 50 ohms, and is 6 cm. long and 3 to 4 mm. thick. The length of the leads is practically unlimited, and their material is either gold, silver or steel, as adapted to the application of the thermometer.

To make the Heraeus resistance thermometer more suitable for handling in factories, it is encased in protection tubes. These tubes may be either steel, lead, or, in the case of acid fumes, silica. The air space between the thermometer bulb and the protection tube is filled out with iron wire, laid around the bulb, thus giving a metal conductor from the protector to the resistance coil. The thermometers have a working range of about —200° C. to +900° C., and are permanent, owing to embedding the resistance coil in quartz.

The Physikalisch-Technische Reichanstalt, of Charlottenburg, Germany, is using these thermometers for calorimetric measurements. To obtain the correct average temperature throughout the entire length of the calorimeters, thermometers with a resistance coil 25 cm. long are used. For the determination of molecular weights; boiling and melting points, thermometers with a stem 2 cm. long are supplied. These thermometers, in connection with the potentiometer as temperature indicator, allow the measuring of 0.001° C., without any difficulty.

For factories, and in such cases where an accuracy of 0.1° C. is sufficient, the Wheatstone bridge is used, in connection with a Deprez-d'Arsonval galvanometer as indicator, but the arrangement used only requires two manipulations for checking the bridge, against three or more movements in older types. The small current consumption of this apparatus makes frequent controlling of the voltage unnecessary. As all the thermometers are calibrated within 0.04%, more than one thermometer can be connected with the same bridge arrangement.

The Heraeus resistance thermometer is used in Germany in chemical, mining, steel and iron industries; also in breweries, schools, hospitals or wherever temperature measurements of less than 900° C. have to be taken. In this country these instruments are distributed by the firm of Charles Engelhard, 30 Church St., New York.

COMPARISON OF SINGLE- AND FIVE-STAMP BATTERIES

	1 Tyler T.C. 9 mesh, 0.205 by 0.536 in.		2 Tyler T.C. 9 mesh, 0.205 by 0.536 in.		5 9 mesh, 0.277 in. square		3 ⅜ in. sq. mesh, 0.375 in.		6 ⅜ in. sq. mesh, 0.375 in.	
	Nissen	City Deep	Nissen	City Deep	Nissen	City Deep	Nissen	City Deep	Nissen	City Deep
Foot-pound-seconds per stamp	23.49	21.99	23.43	21.94	24.23	20.95	28.11	22.54	24.21	20.92
Power, consumption per stamp,* hp.	5.34	5.0	5.33	4.98	5.51	4.76	6.39	5.12	5.50	4.75
Duty per 24 hours per stamp, tons	24.47	18.26	23.73	19.90	29.81	20.95	36.69	22.72	37.74	24.34
Duty (theoretical)	(24.5)	(23.0)	(24.5)	(23.0)	(24.5)	(21.0)	.....	(24.0)	(26.0)	(22.5)
Mechanical value of pulp, energy units	17.25	17.44	17.31	17.52	16.97	16.88	16.88	16.57	16.28	16.31
Relative mechanical efficiency per hp.†	79.0	63.69	90.0	70.0	91.8	74.3	108.4	73.5	111.7	83.6
Increase in efficiency	24.4%		28.6%		23.5%		47.5%		33.6%	

*$\frac{\text{Ft.-lb.-sec.} + 25\%}{550} = \text{hp.}$

†Relative Mechanical Efficiency $= \frac{\text{Duty (Tons per 24 hr.)} \times \text{mechanical value}}{\text{hp.}}$

Exhaust Steam Turbines

In a paper read by P. Barrett Coulston before the Manchester Geological and Mining Society on the use of exhaust steam, reference was made to a mine where noncondensing engines of 1200 hp. were installed. An exhaust-steam turbine, taking about 36,000 lb. of steam, with an electric generator and condensing plant, was then installed, with the following result:

The exhaust steam from the engine which drives the turbine plant gives 1000 kw. or, say, 1500 i.hp.; the 36,000 lb. of steam which must still be generated now yield 2700 instead of the original 1200 i.hp.; and the additional power obtained from the electrical set is being used for different purposes throughout the mine.

Increased efficiency is the chief advantage of the exhaust-steam turbine, due to either excess power for the same quantity of coal expended, or the same power for less coal. There are three points worthy of noting: (1) The capital expended in the installation of the exhaust-steam turbine is low, being only that of the turbine set and its condenser. (2) The space is so small that the plant can almost invariably be installed in the existing engine room. (3) The pipe connections are very simple.

By the introduction of what is termed a "regenerative thermo-accumulator" it is a simple matter to supply steam to the turbine continuously, although the supply of steam from the engine to the accumulator is of an intermittent nature.

The type of accumulator most generally used is a large vessel or container filled with water or other material having heat-storing properties. The exhaust steam from the engine is led into this receptacle, and then supplied to the turbine. When the engine is running and supplying more steam than can be used by the turbine for the time being, the surplus is condensed in the accumulator at about atmospheric pressure, and the temperature and the pressure of the water rise gradually as more steam is condensed. When the engine stops, a drop in pressure at once occurs. As the steam is being constantly used by the turbine, recuperation takes place, and sufficient steam is supplied to the turbine to bridge the gap between the time of starting and stopping the engine.

When the stoppage of operations is of too long duration to be bridged by an accumulator of normal size, it is only necessary to fit a reducing valve, by which means live steam from the boilers can be automatically supplied to the turbine when the pressure in the accumulator falls below a predetermined figure.

Central Compressing Plants at Butte

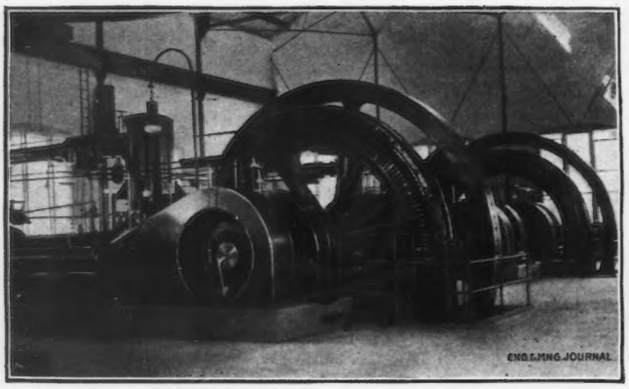
The Amalgamated Copper Co. has adopted the policy of building large electrically driven central compressor plants at its Butte mines. Instead of each mine running its own compressors, there are now four large compressor stations: The Neversweat, the Leonard, the Bell and the new Central plant adjacent to the substation of the Great Falls Power Company.

The plant of the Neversweat mine is the oldest. At this point are installed three 300-hp. and one 800-hp. induction motors driving air compressors. The Leonard, the next oldest, is equipped with two 550-hp. and two 660-hp. induction motors. The third plant, that at the Bell, has four 600-hp. motors. Rope drive is used in the three plants named.

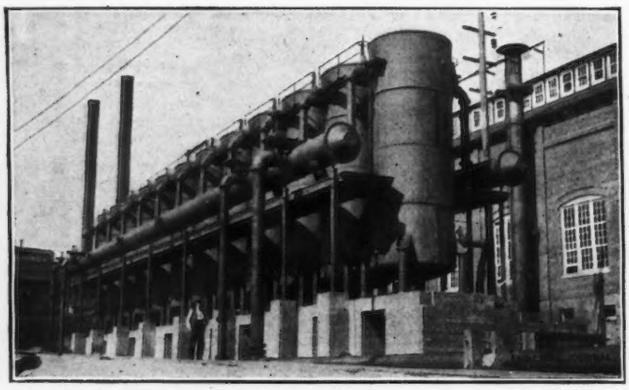
Synchronous Motors Used

For the last plant, known as the Central compressor plant, it was decided to increase the size of the unit over anything attempted previously, to use direct-connected drive, and to install synchronous motors. Accordingly, at this plant are installed three 1200-hp., three-phase, 2400-volt, 60-cycle engine-type synchronous motors built on the shafts of the air compressors. They have an overload capacity permitting continuous operation at 25% overload and 50% overload for one hour. Practically, therefore, they are 1500-hp. motors. On account of the slow speed required, due to their being direct connected to large compressors, they have 96 poles, giving a speed of 75 r.p.m. They were built by the Westinghouse Electric & Manufacturing Co. The dimensions are probably larger than any other synchronous motors ever built for this class of service. Two of these motors are shown in the accompanying engraving. A fourth 1200-hp. motor is ordered and two more of the same size are to be ordered at a later date, making the ultimate capacity of the plant 7200 horsepower.

The economies of electrification are apparent when it is considered that the cost of one horsepower per year generated in the Butte district by steam varies from $80 to $125, while for isolated electrical installations the cost per horsepower year was reduced to from $35 to $60. By centralizing the plants and using large direct-connected synchronous motors further economies were obtained so that in this new central compressor plant the cost will be in the neighborhood of $25 per horsepower year.



Two 1200-hp. Synchronous Motors Driving Compressors at Butte



The Air Tanks at the Central Compressor Plant, Butte, Mont.

The compressors were built by the Nordberg Manufacturing Co. They pump into a large receiver system, consisting of a number of steel tanks; some of these are shown in the accompanying cut. Constant pressure is maintained hydraulically, a huge water tank being situated on a hill some distance above the receivers. The various machines in which the air is used draw upon these receivers. By this arrangement the individual compressors operate continuously at full load and maximum efficiency, large variations in load being taken care of by starting or shutting down an entire compressor unit.

Compressors Started by Air

A novel method is used in starting the synchronous motors. The valve gear on the compressors is arranged with a link motion, somewhat similar in purpose to

that used on a locomotive, but different in design. By means of this link motion, the valve motion may be reversed and by introducing compressed air from the receiver system, the compressor may be actuated as an air engine. In this way a compressor may start its synchronous motor and bring it up to the proper speed for synchronizing it with the power supply line. A refinement has been added to the switchboard equipment furnished at this plant, by means of which the motor may be automatically connected to the supply line when it reaches the proper speed, thus eliminating the necessity of synchronizing by hand. This refinement consists of an automatic synchronizer so arranged that, by means of solenoids, it operates the main switches between the bus bar and each motor. While this automatic feature is not always used it acts as an extra safeguard to render the station more reliable.

A still further safeguard is provided by having the motors designed so that they may be started by supplying current directly to the armature. The field is provided with a cage-type winding, which permits the motors to act as induction motors at starting. This method of starting is used only in case of emergency, when no other means of starting are available. The feature has, however, the great advantage that the plant can still be started from a complete standstill even if there is no air in the storage system.

A considerable quantity of the compressed air from this central compressor plant is used to operate the large hoisting engines at the various shafts in its immediate vicinity. The rest is used to operate the drills used underground.

Since the early part of 1910, when the first synchronous motor was put into operation, it is reported that not a single failure of any sort has occurred, and although the power supply during this time has often been unsteady, with large variations in both voltage and load, none of the motors have ever fallen out of step nor has there been any disposition on their part to "hunt." For this reason it has been recently decided to double the capacity of the original installation.

The electrical energy used is generated on the Missouri River by the Great Falls Power Co. and transmitted approximately 100 miles under a pressure of 110,000 volts to the point at which these motors are installed.

A recent patent for the production of aluminum without the use of a cryolite bath is as follows: Aluminum oxide is reduced with a proper amount of carbon to aluminum carbide (U. S. pat. No. 961,913). The aluminum carbide is then used as a reducing agent for aluminum oxide the electric furnace.

Transvaal Mining Notes

JOHANNESBURG CORRESPONDENCE

The new government mining regulations came into effect at the beginning of the year and they are now as complete and stringent as any in the world. The most important section of the new regulations is that referring to working hours. No person, white or colored, is to be employed underground for a longer period than eight hours. This regulation is interpreted by the mining companies to mean an eight-hour face-to-face shift. The miners are expected to make trouble to obtain an eight-hour bank-to-bank shift. The usual length of shift has been nine hours and had the regulation not included natives the change would not have been so important. As a compromise might have been affected by hoisting the miners at lunch time. The mines have given a month's notice of reduction of wages. The custom in the past was to pay 1½ shifts for Saturday's nine-hour shift. This is to be discontinued, This regulation, I think, threatens to cause trouble and to add to mining costs which are already rising. The white miners' work is mostly supervision and in tramming and shoveling more work can, I think, be obtained from a native in nine than in eight hours.

The labor outlook continues unsatisfactory as the Minister of lands intends to close certain agricultural districts to recruiting. The Rhodesian native labor bureau actively competes in Central Africa, while Nyassaland has been closed altogether to outside recruiting. Better success is attending the efforts made to reduce the terrible death rate of natives imported from tropical Africa. The Chamber of Mines invited Dr. Almroth Wright to visit Johannesburg and it is said that his efforts to procure a serum to inoculate against pneumonia are being successful.

EAST RAND PROPRIETARY CONTROVERSY CONTINUES

The controversy over the East Rand Proprietary fiasco between Doctor Caldecott and the manager Mr. Penlerick continues. Doctor Caldecott adheres to his statement that there was no real shortage and that tonnages were overestimated. Sir George Farrar failed to come to terms with the Corner House regarding the control of the mines and the conflict will be continued until the meeting at the end of February. The underlying cause of the fiasco was that the mine failed to produce the estimated tonnage of ore of a grade of 3 dwt. per ton, which it was reported as being in a position to produce. If it had done so, the directors and managers could have covered up their irregularities easily enough. I am waiting to see when the impatient shareholders will realize this elementary fact and ask pertinent questions.

One is now in a position to judge what the year 1911 has meant in the history of Rand mining. It seems that the best of the profitable ore on the Rand is exhausted and that the mining industry will have reached its maximum output in a few years and has already nearly reached the maximum of profit, if it has not already passed it. A few years will see many well-known outcrop producers exhausted, such as the Jubilee, Salisbury and the Champ d' Or which failed this year. The easily won ore left in the hanging and foot walls of old stopes has been heavily drawn upon during the last three years and the exhaustion of this ore of itself largely accounts for the rise in costs and decline in profits and dividends.

DE BEERS COMPANY WINS SUIT

The De Beers Consolidated Diamond Co. has won its action in the Privy Council against the Rhodesian Chartered Co., and can now lay claim to all diamonds discovered in Rhodesia. The fear of overproduction in the diamond industry has now pretty well been allayed and diamonds are rising in price. Owing to the failure in the grade of the ground and in the quality of the diamonds produced by the Premier Diamond Co., De Beers Consolidated has pretty well resumed control. The policy in the diamond field has been to reduce production to enhance value.

O'OKIEP COPPER MINE NEARLY EXHAUSTED

The copper production of South Africa remains about the same. The famous mines of the Cape Copper Co. near O'okiep on the Atlantic Coast of Cape Colony near the Orange River are approaching exhaustion. The famous O'okiep mine which was one of the largest bonanzas of high-grade copper ore known, is soon to be abandoned. The company has another mine in the northern Transvaal which should at least take its place as a producer. This is the Messina mine, north of Pietersburg near the Limpopo River. Here copper glance exists in shear zones in granite. About 12,500 ft. of length of ancient workings show on the surface, about 2000 ft. has been partially explored to the eighth level and a continuous production has been kept up since 1903.

The distance of this mine from rail communication has hampered progress, but a railway is expected to reach the mines by the end of 1912. Coal suitable for reverberatory smelting has been discovered within 20 miles. Mine development has been most favorable. The main lode where cut at the 800-ft. level was 27 ft. wide and the ore assayed 17% copper; 1500 ft. has been driven on profitable ore on the fourth level and one stope 50 ft. long and 25 ft. wide averages 22% copper. The ore ac-

tually blocked out amounts to 102,000 tons assaying 10% copper and the probable ore above the 800-ft. level to 430,000 tons assaying 10% copper. The estimated profit will be £600,000 with copper at £55 per ton. There is a small concentrating plant at the mines and the picked ore and concentrate exported assay from 40 to 50% copper while there is an accumulation of some 13,000 tons of middlings assaying 12% copper.

The alluvial tin ore produced during 1911 in Swaziland amounted to 476 tons and was valued at £42,250. The gold production chiefly from the Piggs Peak mine was 13,534 oz. valued at £57,530.

Explosives for Coal Mining

The investigation of various explosives forms one of the matters engaging the attention of the Bureau of Mines at the present time. In explosives for use in open air, for example, in quarrying or railroad excavation, strength and efficiency are the qualities which are most important, and usually the only ones that need consideration. Explosives used in tunneling must not only possess strength and efficiency, but must not give off large quantities of poisonous or offensive gases. In explosives intended for use in coal mines, in addition to these two properties, it is important that the explosives should be of such nature as not readily to ignite explosive mixtures of gas or coal dust.

Although it has been found that every known explosive if fired in a sufficiently large charge, will cause the ignition of an explosive gas mixture, the different explosives have been found to differ widely in regard to the amount which can be fired without causing such ignition. For example, ordinary black powder will cause the ignition of explosive gas charges readily, as little as 25 grams serving to bring about this result. Some of the permissible explosives under exactly similar conditions invariably fail to cause ignition of the explosive gas mixture even in quantities as great as 1000 grams.

Those explosives which satisfactorily pass such tests as show that they can be fired in considerable quantities in explosive gas mixtures without causing an ignition, and in addition possess such qualities of stability, etc., as to make them reasonably safe to handle and transport are termed "permissible explosives," and only such explosives are suitable for use in coal mines in which dangerous quantities of firedamp or inflammable coal dust are likely to be met. Although certain explosives may be branded permissible or nonpermissible by the U. S. Bureau of Mines, nevertheless, the government does not compel nor prevent the use of any explosive nor prescribe the conditions of use. It can only advise the public as to the character of the explosives and as to the manner in which they should be used. The authority controlling the use of the explosives lies with the legislatures of the several states and the regulations in different states have been far from uniform.

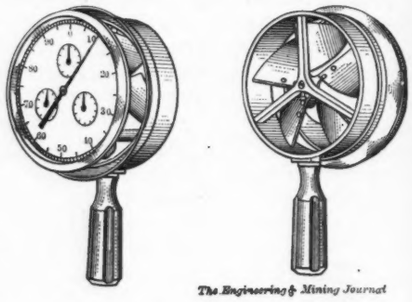
Since an inflammable gas mixture can be ignited either by a high temperature acting for a short interval, or by a lower temperature acting through a longer time, the problem of preparing a safe explosive is that of making a mixture which shall produce a low temperature of short duration and shall nevertheless produce a sufficient quantity of gas to perform by its expansion the work for which the explosive is intended.

In general, the manufacturers of explosives in the United States have cooperated promptly and cordially with the work of the Bureau of Mines, and by Jan. 1, 1910, there had been received at the Pittsburg testing station 51 applications for the testing of 134 explosives. During that year 64 of the explosives submitted were tested and 36 of these passed the test required to place them on the list of permissible explosives. The methods of testing are fully described in Bull. 15 of the U. S. Bureau of Mines.

The Davis Mine Anemometer

A new form of portable anemometer for use in mines has been recently introduced by the English firm of John Davis & Son, Ltd., of Derby. This is illustrated in the accompanying illustrations and is constructed on the principle of the revolving fan invented by Benjamin Biram. It offers several advantages over other forms which have preceded it. The air enters as usual from the back of the instrument, but instead of passing through the protecting ring in a straight line it is deflected outward by a cone through port holes. It would at first be thought that this deflection would introduce a certain amount of air friction, but as a matter of fact the effect of this upon the accurate registration of the instrument is practically *nil*, and it has the distinct advantage that this form of construction enables the instrument to be brought close to the body of the operator without making the readings inaccurate, provided of course, that the bulk of the operator himself does not present so much surface resistance to the draft in a narrow airway as to upset the normal conditions of draft in that portion of the workings.

Another advantage will be noted in the distinct dial face covering the whole circumference of the protecting ring. The instrument has four dials, the large one 13 in. in diameter, including three smaller. The central hand, reading on the largest dial, gives 100 ft. in one revolution, while the three smaller ones give respectively 1,000, 10,000 and 100,000 ft. A handle is provided which screws into the ring of the instrument, and through this handle a plunger passes so that the operator can hold the anemometer, and connect or disconnect the revolving fan from the train of wheels with one hand. The instrument is delicately poised and is strongly protected. From tests which have been taken at the National Physical Laboratory of Great Britain, it has been found that the curve showing the percentage to be added or deducted at various velocities is extremely level throughout the chart, from about 100 ft. to over 3,000 ft. per minute. The dials can be run to zero, and as the instrument records up to 100,000 ft., it can be run in the dark for any reasonable period and then brought into a good light to read. Its small size and portability is a great advantage. It only measures 1½



DAVIS MINE ANEMOMETER

in. from back to front and its total weight is 12 oz. For purposes of checking mine ventilation, therefore, it is an instrument which deserves a considerable amount of attention.

Density of Aluminum

Owing to the high purity of the present commercial aluminum, as compared with that on the market several years ago, when the density and co-efficient of linear expansion were determined for the metal, determinations were recently made by Dr. F. J. Brislee, who reported his results at the sixty-first general meeting of the Faraday Society. The metal used carried 99½% Al, and about ¼% each of Si and Fe. For cast metal the density was 2.708, and for hard-drawn rod, 2.705. Remelted aluminum had a density of 2.68, perhaps due to absorbed nitrogen, as suggested by Dr. R. Seligman. The co-efficient of linear expansion for hard-drawn aluminum is:

$$L_t = L\,(1 - 0.00002432\,t);$$

for annealed aluminum:

$$L_t = L\,(1 - 0.00002454\,t).$$

The above figures for density are greatly in excess of those currently given, as is also Doctor Seligman's of 2.727 for the density of rolled aluminum sheets.

The California Gold Dredge—I

By Robert E. Cranston *

The mechanical features of the California-type dredge, which was evolved from the New Zealand and other types, are critically considered. In this article the design of buckets and tumblers is discussed; buckets are usually made with cast-steel base, pressed-steel hood and manganese-steel lip.

Note—An article entitled "The Design and Mechanical Features of the California Gold Dredge," published in Journ. A. S. M. E., February, 1912.

*Mining engineer, Sacramento, Calif.

This paper deals only with that branch of gold dredging which comes directly within the province of mechanical engineering, and the designs described are those commonly used in California. No attempt is made to cover the whole field, and I have recorded only my personal observations of the more important mechanical features.

Factors Governing Dredge Design

In designing a gold dredge the first essentials to be determined are the quantity of material to be handled and the depth to which it will be necessary to dig. To a lesser degree, the size and quantity of boulders, quantity of clay, nature and contour of bed rock, contour of the surface, whether the dredge is to be operated in a river or in an inland pond, how high above the water line it will be necessary to maintain the bank, the nature and consistency of the gravel, distance from a railroad or other cheap transportation, costs of lumber, labor, electric power, supplies, etc., condition of wagon roads, distance and transportation facilities to a first-class machine shop, climate, distance to nearest public power line, and possibilities of developing electric power on or near the property, are important. If electric power is not available, then the costs of the various fuels for generating steam or running gas engines must be considered, and if the dredge is to be operated inland, how much water is available, and any other data peculiar to the property. All the above information is requisite for the proper design of a dredge to do the most efficient work.

Beginning with the capacity required, the dimensions of the bucket bases, pins, lips, etc., and the horsepower of the digging motor are determined. The depth of ground determines the length of ladder, which is modified by the height to which it is desired to elevate in order to wash and dispose of the gravel properly. The screen pumps and stacker are designed according to the quantity and quality of coarse material and the height to which it is to be stacked. The other machinery is designed to suit the local conditions, and the hull is planned to support the machinery properly, its dimensions varying greatly from the small capacity shallow diggers, to the 16-ft. dredges excavating 60 or 70 ft. below the water line.

The mechanical equipment of the California gold dredge as it is today has in it much to be desired in the way of correct dimensions and the relative strengths of its component parts. Many of these parts should be made stronger, likewise there is much waste material which could just as well be done away with. Notwithstanding these admitted faults the California gold dredge has during the last few years shown vast improvement over the earlier attempts, and with all its frailties has many good points in its make-up which might be profitably studied by engineers called upon to design similar pieces of machinery.

New Zealand Type Dredge

The first successful gold dredges in California were patterned after the New Zealand type. A brief description of one of these, built in 1897 and 1898, will not perhaps be out of place. The hull was built of wood of a rectangular cross-section, having an opening or well extending along the center line part way back from the bow. Near the after end of this well was built an elevated framed structure or main gantry which served to support one end of the digging ladder, the other end being suspended by wire-rope blocks from a head frame or "bow gantry" spanning the well. This ladder was a plate girder upon which were mounted rollers to carry the bucket line. The bucket line was composed of alternate links and buckets pinned together to form an endless chain. The buckets passed over a four-sided flanged tumbler keyed to a shaft and driven by a spur gear mounted on the main gantry. At the lower end of the ladder another tumbler served as an idler.

In going over the upper tumbler the buckets dumped into a hopper leading into an inclined revolving screen with ⅜-in. to ⅝-in. perforations. A spray pipe ran lengthways through the screen, throwing jets of water upon the gravel and washing the finer particles and gold through the screen holes upon gold-saving tables. These tables were covered with cocoanut matting held in place by expanded metal and were arranged so as first to distribute the fine material over a considerable area and then discharge it at the stern; the oversize went to a bucket elevator and was stacked some distance aft of the dredge. The dredge was held up to its work by a head line which could be reeled in by means of a drum on the dredge. Side movement was secured by lines, two at the bow and two at the stern, each running to a separate drum. The motive power for these dredges was steam, which was soon replaced by electricity.

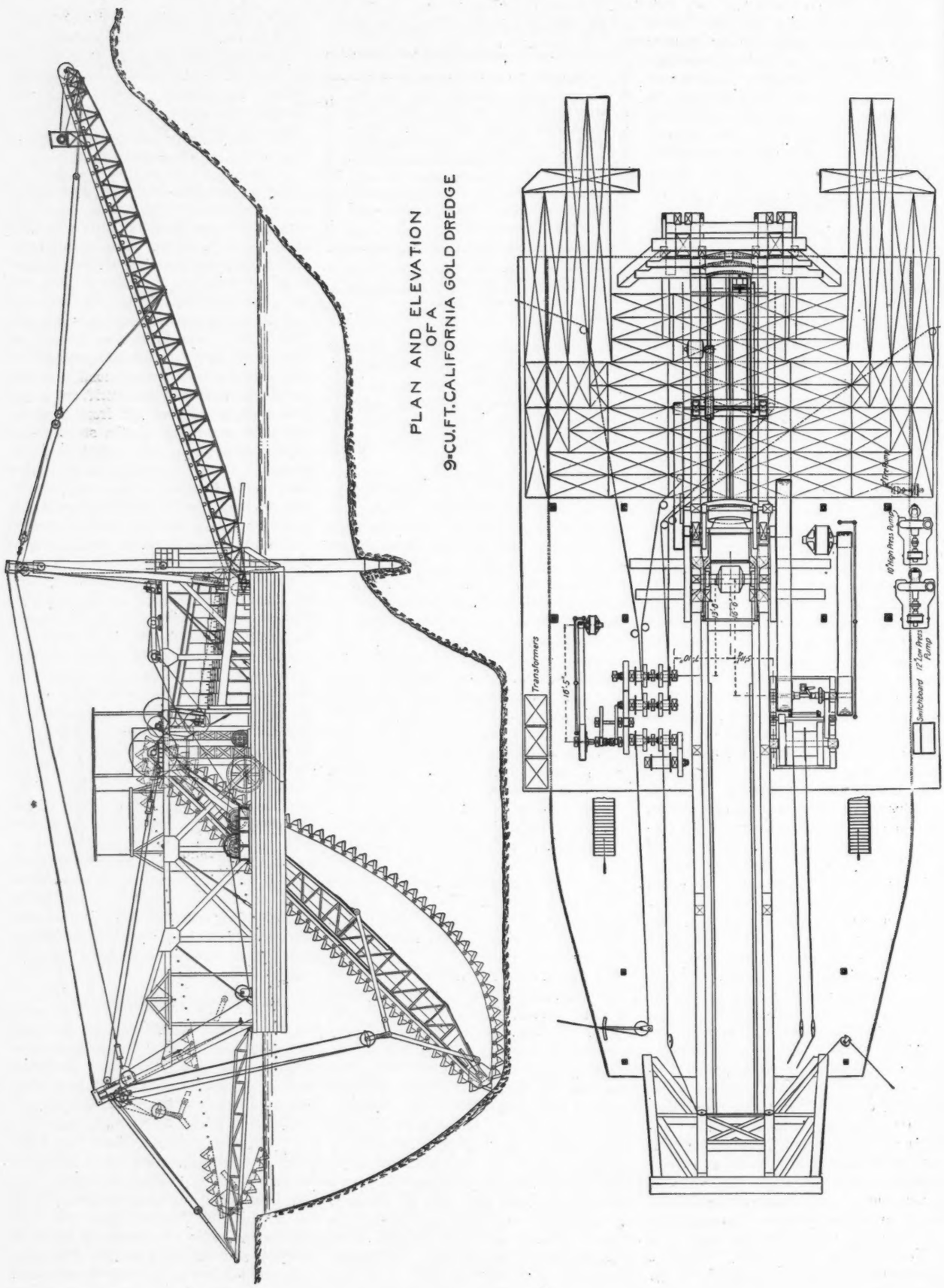
Double-lift Dredge in Montana

Three years before this type of dredge was introduced in California, one of the type known as the double-lift was built near Bannock, Mont. The main gantry was much lower than in the New Zealand type. A revolving screen was used, but the holes were much larger, so that rocks 4 to 6 in. in diameter would pass through. The oversize was dumped at the side of the dredge, and the undersize allowed to collect in a sump from whence it was elevated by means of a centrifugal pump into a sluice running aft from near the throat of the well. At the stern was a pivot connection with another sluice mounted on an auxiliary scow. This scow could be moved from side to side, one end of its sluice being pivoted at the stern of the dredge and the other moving in the arc of a circle, thus distributing the gravel over a considerable area. Instead of a head line, spuds were used to hold the dredge up to its work, the end of the digging ladder moving in the arc of a circle with the spud as its center. About this time several dipper dredges were built, but although some were more or less successful they did not prove to be as efficient as the endless-chain type and were soon abandoned.

In 1899 a double-lift dredge was built at Oroville, and soon after a similar dredge was built on the American River, the latter, however, being of the single-lift type, using close-connected buckets with spuds, no stacker, but having its main gantry high, the buckets dumping into a revolving screen with large holes. This screen was raised high enough so that the finer material fell directly into a fore-and-aft sluice; the oversize dumped into stone chutes discharging on both sides of the dredge.

California Type Evolved

A judicious combination of the best features of the New Zealand and the double- and single-lift types described above, together with several new ideas not used in any of the earlier dredges, resulted in a dredge being built some time in 1901, near Oroville, Calif., equipped with a shaking instead of a revolving screen, the holes in which were small, the fine material going to gold-saving tables as in the New Zealand type, but with Hungarian riffles replacing the cocoanut matting and expanded metal. The oversize was stacked at the stern by means of



PLAN AND ELEVATION OF A 9-CU.FT. CALIFORNIA GOLD DREDGE

a belt conveyor instead of a bucket elevator. Spuds and close-connected buckets were used as in the single-lift type. This general arrangement became known as the California type, and with its later modifications is the one to receive the most attention in this paper, and unless otherwise stated the descriptions are for this type of dredge. A plan and elevation of this type are shown in the accompanying full-page illustration.

The original New Zealand type slightly modified is still sometimes used for the smaller, shallower and richer areas, where it is said to do good work. It is cheaper to build and under certain conditions may prove a better investment than the more expensive California type.

The earlier dredges used buckets holding 3 cu.ft., then the 5-ft. size became numerous, and later the 7-, 8- and 9-ft. sizes were much used. Many went back to the revolving screen, noticeably in localities where much clay existed. In 1905 a 13½-ft. dredge was built near Folsom, Calif., and since that time several with 13½-ft. buckets have been put in operation. Having gained a general idea of the development of this type of gold dredge, its different component parts will be taken up in detail.

Bucket Consists of Three Parts

The bucket proper is made up of base, hood and lip. The base is made of cast steel, many grades being used. It should be hard so as to stand wear, tough so as to stand the strain of digging, and should not be too expensive, since it has constantly to be replaced when worn or broken. All dredge costs are figured on a basis of cents per cubic yard of gravel handled, so that the first cost is not vital so long as it will handle the requisite number of cubic yards before giving out.

The most common form of base has one hub or back eye fitting between the two front eyes of the bucket behind it. Some use two back and three front eyes. The advantage of the three-eye bucket is that a smaller diameter pin may be used, there being four planes of shear instead of two; the disadvantage is that the cost of machining is greater and there seems to be a tendency to crack these buckets between the two back eyes, owing probably to a prying action under hard digging conditions, particularly after the pins are partly worn.

Besides the ordinary high-carbon open-hearth steel, chrome nickel and manganese steels are used. One essential is that the bucket casting should be thoroughly annealed before it is machined. It is my opinion that many breaks in bucket bases have been caused solely by improper annealing.

A template having long guiding bushed holes is useful in drilling for the hood so that the rivet holes will be accurately spaced both inside and out. This is essential in order that there may be no lost time in making replacements. In machining the base the holes in the eyes should be carefully bored so as to be exactly parallel with the hole in the hub. In order to do this the bucket may be fitted with its bushing, a shaft put through the hub, the bucket brought tightly against it, and then the eyes bored parallel to this shaft.

Hoods of Pressed or Cast Steel

The bucket hood is made either of pressed steel or cast steel. There are also buckets used which have the hood cast as an integral part of the base. The pressed-steel hoods are made in either one or three pieces. The thickness depends on the size of bucket and the nature of the digging, and varies from ¼ in. to ½ in. It is sometimes reinforced at the back where the greatest wear occurs. The cast-steel hoods are usually made about ¾ in. thick, have a stiffening rib running up the middle, and sometimes shoulders for the lip to rest on and a shoulder for the base to fit into.

The advantages of pressed- over cast-steel hoods are their cheapness, lightness, and ease of repair if bent or broken. A disadvantage is that the strength cannot always be put where wanted except at extra cost.

A standard drilled base may be used as a template for drilling the hood. I consider the one-piece preferable to the three-piece hood because (*a*) it will stay water-tight; and (*b*) there are fewer rivets to work loose and replace. The disadvantage is the difficulty of pressing a single piece into the proper shape, making the cost slightly greater than if three pieces were used.

Lips Generally of Manganese Steel

Bucket lips are now nearly all made of cast manganese steel. At one time I used an exceedingly hard high-carbon nickel-steel forging, its only advantage being that it could be shaped on the ground to fit several different hoods and bases which it was desired to use up. A record was kept of about 100 of these lips and it was found that for cost and life they were close to the manganese steel. For use in out-of-the-way places and in emergencies they do very well. Their greatest disadvantage is that they cannot be readily forged into the more intricate shapes now commonly used.

The lips in use vary considerably in design according to the nature of the ground and the fancy or judgment of the designer. In the first place, a lip must be made sturdy enough to perform its work without bending or breaking, even up to the time it is ready to be replaced. If it is bent or broken before this time, damage is done the hood, with the resultant extra cost of repairing the hood as well as replacing the lip. The thickness of the lip is determined by the above conditions, but its width is a matter of judgment, since if made too wide the capacity of the bucket is materially reduced by the time it is worn out; if too narrow, it must be replaced often and a large loss made in each replacement both in time and unusual metal.

Some engineers prefer a highly arched digging face, others a rather flat face with sharply rounded corners. Those favoring the arched face contend with good reason that it is a stronger shape, and those favoring the flat face and rounded corners think that this shape is a better digger. The shape of the digging edge is another matter in which designers differ; some make it perfectly straight, others prefer corner extensions at the points where the wear indicates most of the digging is done. I am in favor of the corner extensions, since I believe they dig better and the lip is more completely worn out when it is ready to be replaced.

The fewer rivets used the smaller will be the cost of reassembling, but care must be taken to have enough rivets to do the work without shearing or pulling out. On many of the lip designs a shoulder is cast so that the hood edge fits against it, thus taking much of the strain off the rivets.

Pins, Bushings and Insert Plates

There have been many attempts to improve the design of bucket pins, those ordinarily used being rather expensive to make. It is a round shaft with a flat lug or "L" at one end. The L fits into a slot machined in the bucket base and prevents the pin turning in the eyes. Dowel pins, keys, squared and slotted ends, tee shapes and many other devices have been tried, but so far as I am aware none of them has proved as satisfactory as the old L design.

The pins are made of various kinds of steel, the object being to use an exceedingly hard material which is also tough and not too expensive. A high-carbon steel, low in sulphur and phosphorus, forged, machined, and then oil tempered, is most common. Various forms of nickel, chrome and manganese steel are also used, but so far have not become general practice.

The bushings are made in pairs, half round, and fit a recess in the bucket hub, placed at such an angle that the wear will be evenly distributed. They should be a snug fit, but ¼ in. to ½ in. short on the ends to allow for the flow of the metal. In using manganese steel this tendency to flow must always be taken into consideration and suitable provision made for it in the dimensions.

During the last few years manganese-steel insert plates have come into general use in order to protect the bottom of the bucket base near the hub, at which point excessive wear occurs on account

of the slip on the upper tumbler. Often buckets are found to be worn out at this point but perfectly good everywhere else. The manganese plates are of such a shape that after they are put in place and the softer steel of the base peened over the edges they retain their position without other means of fastening.

Lower Tumbler

At the lower end of the digging ladder the buckets pass over a 6-sided flanged tumbler which revolves between forks attached to the digging ladder. It is cast of open-hearth steel. Wearing plates are used to protect the faces and the flanges. The detail of design varies on different dredges. Some use a tumbler having curved extensions at the corners of the flanges, others have the corners rounded but not extended, and still others use a circular flange. The extended corners require less metal, but are likely to be broken off, and the circular flange may interfere with the digging. The design in which a side view will show a hexagonal shape with rounded corners is strong and cannot well interfere with the digging. The height of flange is another point of difference and varies from 6 to 13 in. at the corners. It must be made high enough to keep the buckets from running off, but if too high may interfere with the digging. It is also expensive.

The slope or flare of the flange varies from zero to 1 in 10. It is claimed by some that if the sides are made too straight the buckets are likely to run off and if the flare is too great the eyes of the buckets will wear thin at the bottom. I do not know that any standard of flare has been adopted, but I am inclined to the belief that a straight or nearly straight flange is best, all things considered.

The flanges and tumbler faces are protected by wearing plates made of some hard steel, nickel, chrome and manganese all being used. So far as wearing qualities are concerned the manganese steel gives the best result, but this material is so hard that it cannot be machined and it is difficult to make the plates fit the tumbler accurately; also, since the rivet holes have to be cored they are likely to be a bad fit. Besides these disadvantages the manganese-steel plates are destructive to the bucket line and it is better to wear out tumbler plates than buckets. Several tumblers have recently been made with a manganese-steel disk set into a recess at each corner and held in place by peening over the edges in a manner similar to the bucket insert plates described above. This method is said to have given good results. Some use separate plates for protecting faces and flanges, while others have the wearing plates made so as to protect both faces and flanges. The advantage of the last method is that the plates are strong and not likely to break or work loose.

The lower tumbler shaft is usually made of nickel steel, either oil tempered, annealed, or both, and may be hollow bored or solid. It should be securely keyed to the tumbler, and I have found that four taper keys, two at each side, 90° or 120° apart, have given the best results. Provision should be made for driving the keys out from the inside and the tumbler should be either shrunk or pressed on.

Cast-steel Ladder Rollers

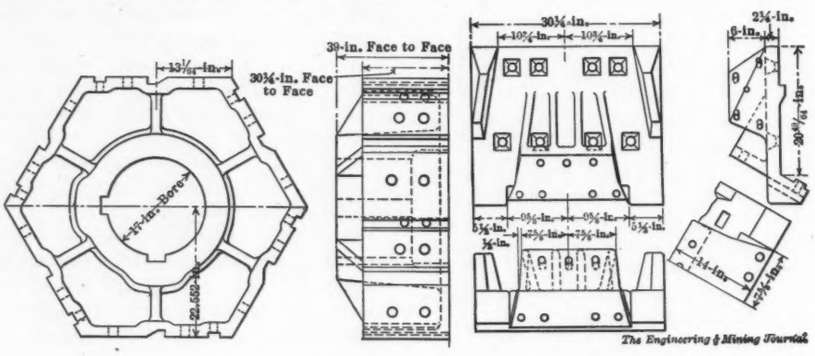
The ladder rollers serve to support the buckets on their way from the lower to the upper tumbler. Cast iron was formerly used, but now cast steel, either high carbon, chrome or manganese, is most in favor. Very hard chilled white iron cast around a soft core has given good results; also manganese steel made in the same way has proved even more efficient so far as wear is concerned. My objection to the manganese roller is that after considerable use the soft core, if made thin, is likely to become loose, and if made thick the difference in expansion of the two metals will cause the outside shell to crack.

A high-carbon or chrome-steel casting makes a good roller, and can be made just soft enough to machine; it will then wear well and need not have a soft-iron core. I have secured particularly good results with chrome-steel rollers made in this way.

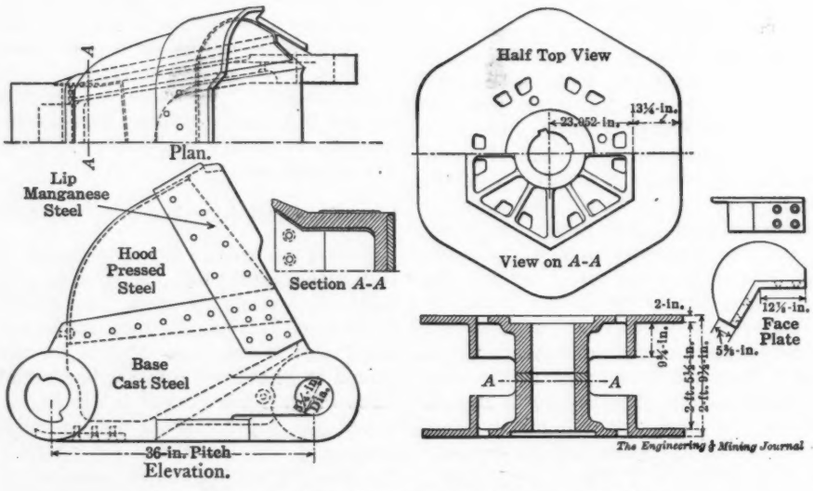
There has always been trouble in keeping shafts tight in the rollers. I use two taper keys at each end, 90° apart, the same plan as for the lower-tumbler shaft. This method of fastening has proved perfectly satisfactory.

There have been many forms of upper tumbler tried, but now the common practice is to use a 6-sided plain casting, to which is bolted a set of heavy cushion plates with guides cast on the sides.

The cushion plates are made to lap over the corners and fit into transverse slots in the tumbler casting. This is done to prevent them from becoming loose, as was the case before this design was perfected. They are made of cast steel, either high carbon, chrome, nickel or manganese. The cushion plates are bolted to the main tumbler casting by means of large bolts 1½ or 2 in. in diameter with square countersunk heads on the outside.



Upper Tumbler and Cushion Plates of a California Dredge

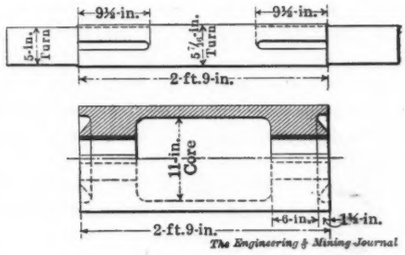


Bucket and Lower Tumbler of a 9-cu.ft. Dredge

Wearing plates are used on the cushion plates, both for the faces and the guide flanges on the sides. These plates may be made of any material desired, but the same objection to manganese exists on the upper as on the lower tumbler. I use plates forged from worn-out bucket pins and then give them an oil temper. These have given good results, but care should be taken not to temper them too hard, since they then become brittle and will give poor service. The wearing plates are riveted with countersunk rivets to the cushion plates. Riveting is better than bolting for this purpose.

Strong Upper Tumbler Shaft Needed

It is imperative that the upper-tumbler shaft should be of ample strength and be made of excellent material since it has to bear the brunt of the digging. A factor of safety of not less than 10 is recommended, and it would do no harm to have it even higher. It is customary to use a material of high tensile strength, since if made of low tensile strength material the shaft will have to be so large that it will interfere with the design of the upper tumbler which it carries. Nickel steel, hollow bored, oil tempered and annealed shafts are much used, having a tensile strength of 90,000 lb., elastic limit 60,000, elongation 22%, contraction 50 per cent.



Ladder Roller for 9-cu.ft. Dredge

Excellent results have also been obtained with Krupp crucible-steel shafts, hollow bored, oil tempered and annealed, having a tensile strength of 80,000 lb., elastic limit 43,000, elongation 22%, contraction 45%. Lately I have used a nickel-steel solid shaft which has been thoroughly annealed, but not oil tempered. This has given excellent results and is inexpensive. The physical properties are as follows: Tensile strength, 80,000; elastic limit, 50,000; elongation, 25%; contraction, 45%. A shaft of soft iron or steel, having a low tensile strength, but great toughness, such as Lloyds' test steel, would be the ideal shaft for this purpose were it not for the necessity of making them so large that there is no room left to fasten the cushion plates to the upper tumbler. By using a 7- or 8-sided tumbler this difficulty could be overcome.

(To be continued)

Review of Cobalt

Special Correspondence

Cobalt offers the distinction of being one of the richest and most interesting mining camps in the world today. Silver was first discovered in 1904, and the following year a few tons of rich ore were shipped. Year by year the output has grown until at present the few square miles that comprise the Cobalt mining area, hold third place in the silver producing communities of the world, being exceeded only by Mexico and the United States. In 1910 the production amounted roughly to 30,000,000 oz. of silver, and estimates for 1911, place the output at 32,000,000 ounces.

Veins Narrow and Shallow

The veins are generally narrow, averaging between 2 and 3 in. in width, and they do not extend to any great depth, the greatest part of the ore having been obtained above the 200-ft. level. The grade of the ore is such, however, that these small veins can be worked at a large profit. Production costs for the camp average about 15c. per oz., while the costs for one mine, extending over a period of a year, have been as low as 7c. per ounce. The ore is practically all found in the conglomerate; while some silver has been produced from the diabase and Keewatin formations, over 90% of the total output has come from the conglomerate. There has not been a single mine working solely in the diabase, which has been a commercial success.

When the ore was first discovered it was generally believed that the camp would have a short life. The high-grade portions of the veins were gouged out and but little attention was paid to economical mining methods. When it was seen, however, that the deposits were much more extensive than was at first believed, better methods came into vogue, and while Cobalt mining practice cannot be classed as economical, in general the methods followed are those best adapted to the development of the small but rich veins.

Mill Losses High

Concentration naturally followed and while first attempts were rather crude, a general system applicable to the district has been worked out, and there are now 13 concentrators in the camp, treating the low-grade ores and making excellent recoveries.

It is safe to say, however, that the losses in the majority of the mills are altogether too high. The latest development in the milling practice is the method worked out for the Nipissing ores by Charles Butters, by which, after the coarse ore has been removed by jigs, the rest is cyanided. The original process, consisting of amalgamation and cyaniding, was applied only to the high-grade ores, and it resulted in a material saving over custom treatment. Further work indicated that with some modifications the process could be applied to the low-grade ores, giving an extraction considerably better than was being obtained by the other mills of the district. The Nipissing company is now engaged in the construction of a mill of 200-tons, daily capacity, the practical working of which will be watched with great interest.

Record Production in 1911

While the shipments have been steadily increasing it is probable that the last year will show the record production and that while the output may remain at the same level for a year, there will then come a gradual but steady decrease. While this statement is open to criticism, it is believed that an analysis of the situation will bear out its truth. As stated before, the veins of the district are narrow, and in the majority of cases, have no great depth. With a heavy production these are soon exhausted, and shipments have been maintained by the discovery and working of other new orebodies. In 1909 and 1910 a great many new veins were found, but during 1911 practically no new discoveries of importance were made. The majority of the companies have pretty clearly defined the limits of the mineralized area, most of the available ground has been prospected, and a good idea obtained as to the ore reserves. While the production as a whole has been increasing, the output from many of the smaller companies has been showing a steady decrease, and this has been made up by the increased production of the larger companies. During the last two years, the latter have been increasing their output largely by more extensive development work and by enlarging their mills. It is probable, however, that they have now reached the ultimate productive capacity to which it would be economical to force them, and that while they will maintain a more or less steady output for some time to come, they will no longer be able to supply the deficiency created by the decreased production of the others.

This does not imply that the future life of the camp is short, for although the smaller companies will soon begin to drop out, the larger mines have a long life ahead of them yet, and the Cobalt district is bound to retain its place as an important silver-producing community for many years.

Ferrochrome, ferrosilicon, ferrophosphorus and some other similar alloys are made in Canada in the electric furnace at Sault Ste. Marie and Welland, in Ontario, and at Buckingham, in Quebec. The quantity is not large, the total make last year not exceeding 5000 tons.

Secondary Sulphide Enrichment

By Horace V. Winchell*

Secondary sulphide enrichment the work of surface waters. An "iron hat" containing no sulphides, its invariable concomitant when the enriched veins are profitably large. Instances of secondary enrichment at the surface. Wide field for future study.

*Mining geologist, 505 Palace Building, Minneapolis, Minn.

Sulphide minerals are found in nearly all veins and ore deposits and are evidently formed by various agencies. Thus, pyrite and chalcopyrite are known to be constituent minerals of deep-seated as well as extrusive eruptive rocks. They are also frequently found under conditions which admit of no other explanation than that of deposition from aqueous solution; in fact, they may be so produced in the laboratory.

Until within about 15 years, geologists never realized that sulphide minerals could be deposited in veins through the agency of surface waters. The fact that these minerals are seldom found in the zone of weathering, and that they are readily destroyed by oxidation within that zone, made it appear that the solutions or vapors or other agencies which deposited them, must in all cases have been derived from some subterranean source.

The Iron Hat Supposed to Mark the Rich Vein

For hundreds of years miners and prospectors have discovered that those veins whose upper portion is decidedly iron stained and weathered are apt to be rich below this zone of weathering. The name given to this zone by the Germans is "iron hat" and the statement is proverbial,—"No vein so good as that which wears an iron hat." Here we have the early recognition and expression of a most important fact, a fact whose explanation has only of late years been determined. Of course, the opposite of this proposition is not always true, nor has it always been kept in mind. Those veins which have no hat at all may be rich, but if they are their wealth must be chiefly due to the character of their primary mineralization.

Secondary Enrichment Defined

By the term secondary enrichment is specifically meant that enrichment which is due to the action of surface waters in taking into solution the sulphate minerals produced from the sulphides by oxidation, carrying these minerals downward into the vein and redepositing them there. Such sulphide enrichment seldom produces ore deposits at great depth below unoxidized and unenriched primary material. There may be more than one period of primary mineralization. The same minerals may in some instances be deposited at great depth through the operation of ascending waters, enriching and enlarging other deposits already formed, but such deposition is by no means as common nor its products so important as that which is accomplished through the work of meteoric or surface waters.

Since ore deposits have been formed at various periods of geologic history and in rocks of all ages, it must be apparent that secondary enrichment has been going on to a greater or less extent through the operation of the agencies of weathering in every deposit of sulphide ores exposed upon the surface of the earth since the time of its formation from the Archean era to the present time. That there were periods of excessive and unusual primary mineralization is unquestioned, and that much of this mineralization has been deposited in comparatively recent geologic time is also admitted. But, in addition to the process of oxidation and of redeposition, there has taken place erosion or wearing down of the surface rocks and minerals; and the extent to which the oxidized products have been preserved within the limits of the vein depends to a considerable degree upon the relative rates of oxidation and erosion.

Copper and silver are the two metals peculiarly susceptible of concentration by secondary sulphide enrichment. Other metals are likewise concentrated through the same general process, and a most important and valuable investigation into the subject of the secondary enrichment of gold ores through the agency of manganese was published about a year ago by Prof. W. H. Emmons. This little monograph already ranks as a classic and is one of the principal guide posts on the road to the why of gold ores. Without going into the chemical reactions involved in this alteration of ores through processes of sub-aërial decay and their downward migration, I wish, for a few moments, to call attention to some of the conditions necessary for such an operation.

Circulating Water the First Requisite

In the first place, it is obvious that as a prerequisite for such enrichment ores must either outcrop at the surface or must be within the zone of circulation of oxygen-bearing waters.

In the second place, as already suggested, the work of these waters must be chemical rather than mechanical. The outcrop of a vein beneath the bed of a rapid stream could hardly be expected to oxidize more rapidly than erosion proceeds, and whatever sulphates are formed under these conditions will be, for the greater part, carried away along with the waters of the stream rather than directly downward into the vein. Conditions of alternating moisture and dryness are, in general, more favorable for rapid oxidation than a condition of permanent saturation. Of course, the amount of oxidation that will take place in a perfectly dry spot is imperceptible. The temperature of the solutions passing over vein minerals has much to do with the rapidity of chemical change. A difference of a few degrees seems to retard oxidation to a marked extent.

Vein Structure Influences Oxidation

The structure of the vein filling, the existence or absence of cavities and of channels through which surface waters may find their way, also govern to a large extent the progress of oxidation and chemical change. Thus, for example, disseminated pyrite, in the gouge of a fault, may be protected from oxidation, although the apparently solid quartz containing sulphide minerals in the vein along side of this gouge may be oxidized to great depth. The character and nature of the combination of the sulphide minerals themselves has a great deal to do with the extent to which chemical change takes place within a given time. Thus, the ordinary sulphide of iron is less susceptible to oxidation than pyrite containing a small admixture of chalcopyrite or other copper sulphides. Where the sulphide minerals are associated with feldspathic minerals, which have been more or less crushed by earth movements in the vicinity of or within a vein, as in Butte, the readiness of these feldspathic minerals to become hydrated seems to facilitate the oxidation of the associated sulphides.

This point is well illustrated by contrasting conditions as observed at Butte with those seen in Sweden and Alaska. In Butte, pyritic material consisting of a mixture of ore and crushed granite, composes many mine dumps. Oxidation proceeds so rapidly even in cold weather that the surface of these dumps is more or less encrusted with the light green and blue sulphates of iron and copper and there is actually enough heat de-

veloped by the process of oxidation to melt the snow much more rapidly, especially upon southern exposures, than melts the snow which covers the completely oxidized country rock immediately adjacent and likewise facing south. The tailings from the concentrates of Butte and Anaconda are, of course, finely divided, and therefore present a maximum surface to the action of the weather, and they are so rapidly oxidizing that a profitable business is conducted in pumping the water from central wells, sunk in these tailing piles, and precipitating therefrom the content of copper.

Unoxidized Outcrops in Northern Countries

In Alaska, on the other hand, and in Sweden, sulphide ores outcrop almost immediately upon the surface. They have been exposed to the chemical action of the surface waters for hundreds and thousands of years, and yet, in some cases, oxidation has effected almost no visible decomposition. At the Falun mine in Sweden the outcropping massive pyrite, inclosed in crystalline limestone, still bears the marks of glacial striation. It is known from the studies of the Swedish glacial geologists that those glacial markings were carved into the ore more than 3000 years ago. In some places moist glacial till has covered the scarred surface until within a year or two, and yet the pyrite is as fresh to-day as the day the ice retreated, and the adjacent marble is not visibly discolored. To how great an extent this resistance to oxidizing influences has depended upon the composition of the sulphide mineral and its density and how far it has resulted from the low isothermal of a northern latitude, it is impossible to state without careful analysis and examination of the pyritic ore to determine its copper content and its physical structure.

An Instance of Alaskan Secondary Enrichment

That oxidation has occurred in Alaska in ages past, there can be no doubt, but its products have been almost entirely removed by glacial erosion and by the rapid wearing down from excessive rains and torrential streams; and still, even in this northern country, I have observed two remarkable examples of secondary sulphide enrichment which are worthy of brief description.

In the Copper River country, copper minerals are particularly abundant in the vicinity of an eruptive rock called the Nicolai greenstone and along its contact with the Chitistone limestone. The copper is native and in various sulphide combinations. Pyrite is fairly abundant and there is occasionally a little blende and galena. The valleys are filled in their higher portions with glaciers, and the water emanating from these glaciers is almost ice cold. The gradients of the rivers and creeks are steep and the current rapid. The creek beds are filled with boulders, which are constantly making their way down stream, frequently with a rumble and a clicking, perfectly audible above the noise of the dashing waters. Just above the bedrock, which is seldom at any great depth, the heavier substances accumulate. Here we find boulders and pebbles of native copper, grains and pebbles of unoxidized sulphide minerals, rounded pieces of heavy spar, and grains and nuggets of gold. There is, of course, some organic matter in these waters, but, as a rule, the water is extremely cold and fresh, and save for the abundance of milky sediment, decidedly palatable.

In prospecting for gold the miners dug numerous test pits and trenches through the gravel in the beds of some of these streams to the underlying rock and in washing the gravel, many copper nuggets remained in the sluice boxes. The larger nuggets are usually coated with green copper carbonate. Inclosed within this green carbonate coating may frequently be seen minute scales of native silver and sometimes flakes of gold. There is nothing remarkable about this, but some of the smaller copper nuggets were found to be completely inclosed within a matrix of secondary copper sulphides consisting of chalcocite and bornite and frequently containing also pebbles of pyrite and nuggets of gold. Many such small copper nuggets were collected.

Here appears to be an instance of secondary sulphide enrichment in cold waters in recent times in the presence of an excess of oxygen and outside of any vein or ore deposit in place. The explanation of the formation of copper glance under these conditions is difficult. It may possibly have been formed through the oxidation of pyrite, the formation of sulphuric and sulphurous acids, the former of which immediately dissolved some of the metallic copper from adjacent nuggets, and the latter of which reduced the cupric sulphate to cuprous sulphate, which was in turn transformed into cuprous sulphide and deposited as copper glance upon the very nugget of copper from which the copper was taken by the sulphuric acid. This occurrence alone is a complete demonstration of the possibility of the formation of sulphide minerals upon the surface of the earth at ordinary temperature and pressure, and nothing more would be needed to refute the statements so common 20 or 25 years ago that sulphide minerals can be formed only through the agency of hot, ascending solutions.

Instances of Above-Ground Sulphide Formation

Other instances of the formation of secondary sulphides under atmospheric conditions can be seen in many places along the Pacific coast of Washington, British Columbia and Alaska. The rocks here are prevailingly crystalline and frequently carry a considerable amount of visible sulphide mineralization. The minerals are pyrrhotite, pyrite, and chalcopyrite. The hillsides are covered with a heavy growth of evergreen forest and the snow lies upon the ground for more than half of the year. During the other months the ground is full of water flowing down through the roots of the trees and over the surface of the glaciated rock beneath the soil.

Where the sulphide minerals are particularly abundant I have seen a superficial plating of ore entirely covering the underlying rock to the depth of from an inch to five inches. In such places the casual observer would conclude that the entire mountain is composed of massive sulphide ore. A sample broken from immediately upon the surface will assay perhaps 7% copper and $1.50 per ton in gold and silver. Careful examination of the material broken from projecting knobs and points will show a layering or banding, and careful sampling discloses a rapid diminution in copper percentage away from the immediate surface. At the depth of six inches the sulphide substance is more or less mingled with rock and the copper content is only about 0.5%. At greater depths the entire blanket rapidly changes into solid rock, carrying no appreciable copper or precious metals. In such localities as this there may be in sheltered depressions some limonite and some copper and iron sulphates showing surface weathering. Usually there is no considerable quantity of these materials and the surface of the rock is dark, bronzy black. Here we have a different problem presented. Why was chalcopyrite formed instead of chalcocite? What are the conditions under which, in a northern clime, immersed in snow water and covered only by soil and the roots of trees, such a blanket could have been formed since the departure of the glacial ice mantle? In more southern countries such a thing would be impossible, except at great elevation, and even there it has never been reported.

These are only curious examples of secondary sulphide enrichment and their only significance and commercial importance is to serve as a warning to the prospector rather than an encouragement. Generally speaking, secondary enrichment is not as abundant and does not extend to such great depth in northern, cold, semi-arctic regions as in the

semi-arid districts two thousand miles farther south.

Most Big Copper Camps Due to Secondary Enrichment

The importance of a thorough understanding of secondary sulphide enrichment in connection with the examination and appraisal of copper mines can hardly be overestimated. With the possible exception of Butte, most of the large copper camps of the country owe their importance to secondary enrichment. Without it there would be no Bisbee, no Utah Copper, no Nevada Consolidated, no Ray Consolidated, no Chino, and possibly even Butte would remain to-day still undiscovered.

It was at Butte that the first laboratory experiments were made, demonstrating the possibility of the formation of chalcocite from sulphate solutions, and there can be no doubt that a portion of the rich ore mined in the upper levels of that camp has been produced in that way, through the action of descending meteoric waters. There can be no doubt, upon the other hand, that there is in Butte a large amount of primary chalcocite, and it is a matter of exceeding difficulty to determine what portion of this pure copper mineral is primary and what portion secondary.

Enargite, chalcopyrite and covellite also occur in the veins at Butte, and in many cases are clearly secondary. Indeed, the geologic history of the Butte camp is so complex and there has been such repeated working over of the primary vein material and such transportation and transmigration from one part of a vein to another, that it has thus far been impossible to unravel the threads of its history and to say precisely what was the nature of the genesis of its ores.

Secondary Enrichment Can Occur Only Under an Iron-Oxide Hat

The mining geologist should always bear in mind the fact that secondary sulphide enrichment can occur only where there is for a long period of time an overlying, protecting gossan, or zone of oxidized material, and this "iron hat" is not composed of sulphide materials, either primary or secondary. I was much surprised during the trial of a case recently to have the professor of mining engineering in a state university testify that the general prevalence of an iron hat in the Mount St. Helen's district in Washington was in itself sufficient indication of the existence of enriched ore deposits below. When asked what minerals he observed composing this iron hat, he blandly replied: "Pyrite, chalcopyrite and some other sulphide minerals, together with a certain amount of magnetite and specular hematite." And upon examination of the history of this district, I was amazed to find that about 11,000 ft. of tunnels have been driven by mining companies and individuals in the vain hope of discovering mines underneath this kind of iron hat.

It should also be borne in mind that where the country rock adjacent to the veins is comparatively fresh and shows but little evidence of weathering, there is not likely to be great depth to the secondarily enriched zone in the veins, even though they appear to have an excellent gossan.

Change of Ground Water Level Most Important

One of the most difficult questions, and yet one of considerable practical as well as scientific importance in connection with the study of mining districts, is the question of the alternate rising and lowering of the ground water level. It is a fact well known to miners that in the same district two shafts, a thousand or 1500 ft. deep, one may be dry and the other wet. It is also easy to discover in some mines in desert countries evidences of a former water level hundreds of feet higher than that which prevails to-day. Under these conditions it is readily seen that surface waters may have been able to penetrate to greater depths during some periods than at others, and there may be in some cases a masking or disguising of the evidences of secondary enrichment, or even a double series of such deposits within the same vein.

The latter phenomenon is a possibility in another way, through the agency of faults, which may bring oxidizing solutions directly from the surface down to the lower part of a vein and there produce ore chutes of secondary enrichment which would have been impossible if the surface waters had been compelled to travel for the entire distance along and through the vein minerals.

This theory of secondary enrichment is so attractive and explains so readily many phenomena connected with the universal impoverishment of sulphide ores with depth that it has been eagerly adopted. The Germans, to be sure, hardly seem to realize its true significance, and in their later treatises upon ore deposits give scanty space to a description of this class of deposits, but under the heading of secondary enrichment discuss chiefly secondary oxides and carbonates and chlorides; but the geologist should be upon his guard lest he be tempted to see in a given district indications of important secondary deposition which the facts, rightly interpreted, do not afford. In this connection, I am reminded of recent descriptions of the sandstone copper deposits of Katanga in Africa. These descriptions are written by a German geologist and published in the *Zeitschrift für praktische Geologie.* Although few traces of sulphide minerals have yet been encountered, and although no one else has ever thought of such a thing, this writer states without hesitation that these enormous deposits, a large part of which are admittedly within a sandstone, are the oxidized upper portions of enormous bodies of sulphide ore below, and gives it as his opinion that there will be found bonanzas of copper glance and bornite below the zone of oxidation.

Every geologist should be equipped with an active imagination, but, unless supported by facts, it should not play too large a part in the enunciation of his conclusions.

The Value of The Mine Geologist

The practical value of geological work in the elucidation of the structure of ore deposits is rapidly becoming better appreciated by those engaged in the operation of mines. Only a few years ago the average mine superintendent was extremely skeptical as to the desirability and usefulness of a mining geologist. Knowing nothing of the subject himself, and perhaps for that reason prejudiced against those possessed of technical knowledge, the manager of a mine could soldom be brought to an appreciation of the possibility of deriving real benefit from the detailed mapping of his underground workings. In fact, the opportunity for the geologist to demonstrate the value of his services arose in many districts only after the mines had become nearly exhausted or the grade of the ore had declined almost to the limit of profitable exploitation or until the veins were faulted and lost or until vexatious and expensive mining litigation arose concerning the ownership of extremely valuable deposits of minerals. Once given the opportunity, however, the economic geologist quickly justified his title and profession. The decisions and definitions of the highest courts in the land are based upon the testimony given in hotly contested lawsuits by geologists. Untold millions of wealth have been saved or discovered through the careful, plodding investigations of the mining geologist. Indeed, the life of some of our most important camps has been indefinitely prolonged by the intelligent working out of the problems connected with the origin, structure and location of the ore bodies; and today almost every large mining company not only recognizes the importance and value of such work, but includes upon its staff the services of either a regular or a consulting mining geologist.

Undetermined Problems of Secondary Enrichment

The most important field of investigation for the economic geologist in the future is that connected with the interpretation of oxidation phenomena and the extent of secondary enrichment. There must be some method of determining from the character of the minerals in the upper zone of a vein or ore deposit and from the study of the associated rock formations whether or not important deposits of ore may be confidently expected below the zone of weathering. It must be possible to distinguish between the chalcocite, bornite, galena, and various other sulphide and arsenide minerals deposited by ascending waters and the same minerals deposited by descending solutions.

Many ore deposits remain today unsuspected and undiscovered simply because there are no surface indications of their existence, intelligible in the light of our present knowledge. Superficial oxidation of the outcrop of a great copper mine may, for example, be carried on in a district where there is no limestone and where the various elements of the minerals which compose the ore bear such a relation to the oxidizing agents that every trace of copper is carried away and there is no discoloration nor any deposition of the oxidized copper minerals remaining, to attract the eye of the prospector and stimulate the efforts of the miner. This was almost literally true of the Butte copper mines, which are known to be the most important that have been discovered. There is scarcely a trace of copper mineralization in the outcrop, nor within the upper hundred feet of the most important copper veins in that camp. If it had not been for the fortuitous association of a later series of silver veins of different structure and composition, whose outcrops furnished placer material and whose secondary ore was deposited near the surface in the form of mixed chlorides, arsenides, sulphides and antimonides, it is entirely probable that the great masses of copper glance which have contributed about two million tons of pure copper for the world's consumption would not yet have been discovered.

How many more such deposits may still lie ready to reward the efforts of the intelligent prospector or the investigations of the uptodate mining geologist, there is no possible method of telling, but it is certainly stimulating to the imagination and suggestive of the importance of the most careful study in the field of the why of secondary enrichment.

All Bonanzas Not Yet Discovered

There has been a tendency within the last two or three years upon the part of some of our prominent and most successful mining engineers to discourage the expectation of the discovery of more large mines in this country. Just because those deposits whose existence was obvious to the most casual observer, those mines which flaunted the gaudiest colors and the most imposing outcrops in the face of every passer-by have been, for the greater part, developed and turned into famous producers, there is no reason to give up all hope of the discovery of the more modest-hued and retiring centers of mineralization, whose value may be as great or even greater than that of the more brazen and ostentatious creatures.

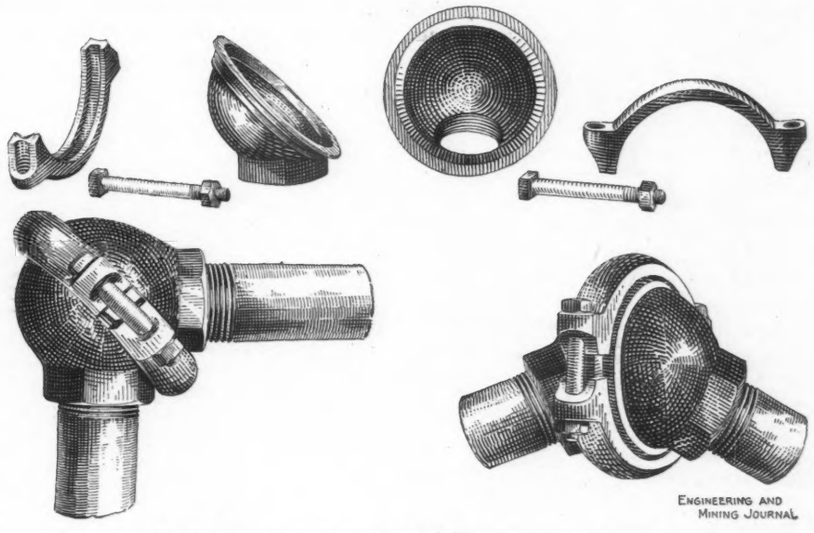
I am a thorough believer in the future of this country and in the possibilities for almost unlimited development in the West, and I would hold out every encouragement to the student of mining and geology, particularly in the investigation of the as yet but partially revealed secrets of secondary sulphide enrichment, for, in the language of Job, the oldest authority on prospecting: "Surely there is a vein for the silver, and a place for gold where they fine it."

An Adjustable Elbow Union

The adjustable elbow union shown in the accompanying illustration is a new pipe fitting that is being manufactured by the E. W. & L. K. Peck Co., of Grand Rapids, Mich. The structural details of the fitting are clearly shown in the illustration. The device consists of two hemispheres with tapered flanged edges. A two-piece band that can be drawn together by two bolts and the inner face of which is recessed to receive the flanges, encircles the flanges and binds them together, no gasket being necessary to make a tight joint. The two bolts may be tightened so as to draw the recess of the band down tightly over the flanges, their trapezoidal section or taper bringing the flanges tight together as the band is drawn down.

The median line through the pipe connection makes an angle of 135° to the line normal to the plane of the flange. The two hemispheres are free to revolve in the plane of the flanges so that the piping can be put together at any desired angle by revolving one hemisphere to the desired position before drawing the fitting tightly together with the band bolts.

The fitting takes the place of an elbow or bend, a nipple and a union. It has a further advantage in that removal of the band permits drawing the pipes apart at the turn so that there is a free straight-away passage down the pipes in either direction, making it an easy matter to run a rod through either of the pipe legs to remove any obstructions that may exist in them. This feature would appear to make the fitting of particular utility in mills or cyanide plants in such pipe lines as are used for conveying pulp and tailings, thus taking the place of the cross and two plugs, sometimes used instead of an elbow.



An Adjustable Combination Elbow and Union

Cost of Power Installations

The cost of power installations using a steam prime mover and electric generators is discussed in the *Journal* of the Association of Engineering Societies, Jan., 1912. The figures given for a station of this type having steam turbines, with coal costing $4.25 per ton are as follows:

Size plant, kw.	Cost per kw. of capacity	Power cost per kw.-hr.
1000	$125	1.25c.
2000	110	1.08c.
3000	100	1.00c.
4000	95	0.96c.
5000	90	0.94c.

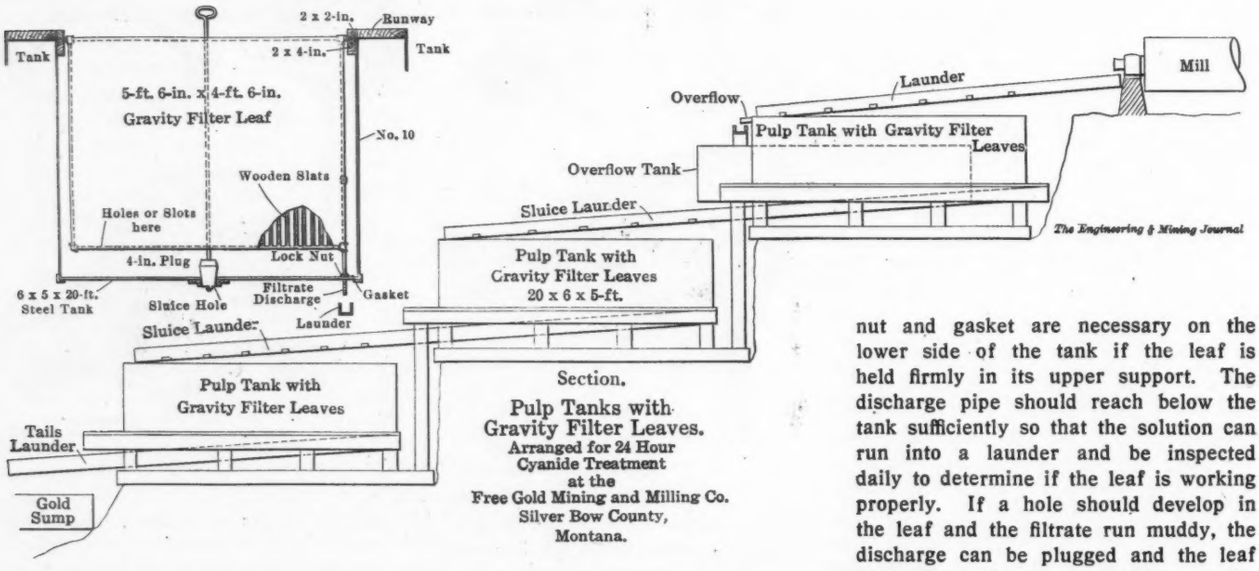
A Gravity Filter Plant

By C. J. Stone*

Filter leaves of the Butters type are suspended in slime tanks, the solution passing into the leaves and out through the frames without the aid of vacuum or pressure pumps. A small plant of this type is in operation in Montana at an isolated mine producing low-grade free-gold ore.

*Superintendent, The Butte-Alex. Scott Copper Co., Butte, Mont.

The problem of a suitable milling equipment for a gold property under consideration by an engineer, is always a serious one, and one that is beset by many chances for error. Although the fundamental principles of cyaniding are sufficiently understood, the best mechanical method of treating the ore to obtain the maximum extraction with the least cost of equipment and operation is the main problem. For the engineer to develop and recommend an original equipment for each property that might come under his immediate supervision, is out of the question. Manufacturer's literature is full of schemes and methods for handling cyaniding ores and many equipments in detail have come under his own observation. The simplest equipment with the least expenditure possible, which promises results and low operating and maintenance costs should always be advised.



Pulp Tanks with Gravity Filter Leaves. Arranged for 24 Hour Cyanide Treatment at the Free Gold Mining and Milling Co. Silver Bow County, Montana.

Used at a Montana Mine

On this point, the use of the gravity filter leaf has much to recommend itself to engineers, when better understood. Their use seems especially well adapted to small low-grade free-gold properties, and properties at considerable distance from transportation. The Free Gold Mining & Milling Co., operating in Silver Bow County, Mont., has developed the use of this leaf satisfactorily, and a description of its use and results obtained may be of interest.

The term "gravity filter leaf" is used because the solution filters through it by gravity only, in place of being drawn through or into the leaf by vacuum pumps, or being forced through by pressure pumps, as is the general practice. The filter leaf consists of a rectangular frame of half-inch standard black pipe with the perforations or slots for the filtrate to pass from the filter in the bottom pipe only. The filling consists of slats or strips of wood placed vertically. No cocoa matting is necessary. The frame is placed in a canvas sack covering the whole and the opening is closed and sewed over the top supporting rod. The size of leaf which gives the best results is from five to six feet long by four to five feet deep. A larger leaf can be used but the strain and wear to which it is subjected, makes it shorter lived. An accompanying sketch shows its simple construction and its method of support and discharge.

A steel tank of No. 10 thickness, 20 ft. long, 6 ft. wide, by 5 to 5½ ft. deep gives good results. The discharge gates are 4-in. flange openings in the bottom. They are closed with a soft red-wood plug which has a long handle that reaches about a foot above the top of the tank. No trouble develops in removing the plug when it is desired to sluice the tank. The discharge gates can be two or four feet apart as desired and placed along the center of the tank bottom.

The leaves are suspended in the tank from their top cross bars which rest on both sides on a strip or piece of 2 x 4-in. scantling bolted to the inside of the tank. Half-inch notches are cut into the scantling as often as the leaves are necessary. A 2 x 2-in. strip in short sections should be bolted to the sides directly above to hold the leaves firmly in their notches thus preventing them from floating up when the tank is being filled. The discharge from the leaves through the bottom of the tank is effected through a punched hole for a ½-in.. pipe. The discharge pipe of the leaf is placed through the hole and a lock nut and a soft rubber gasket prevent leakage. No lock nut and gasket are necessary on the lower side of the tank if the leaf is held firmly in its upper support. The discharge pipe should reach below the tank sufficiently so that the solution can run into a launder and be inspected daily to determine if the leaf is working properly. If a hole should develop in the leaf and the filtrate run muddy, the discharge can be plugged and the leaf replaced at the next emptying of the tank.

Number of Leaves Required

The number of leaves necessary per tank will depend upon the character of the ore and the fineness to which it is necessary to be ground to obtain a satisfactory extraction within a given time. On a 24-hr. treatment the above company is using 30-mesh slotted screens in Huntington mills, and 30% of the pulp will pass 200 mesh. The leaves are placed 8-in. between centers, and within 6 hours a tank will leach to 25 to 30% moisture. A pulp with 50 to 60% slime will require 40 to 50 leaves per tank to effect a rapid filtering. Sixty leaves will give 1485 sq.ft. of filtering area.

The tanks are placed on benches with sufficient elevation if possible to obtain

satisfactory gravity sluicing from the upper series to the lower. A sketch shows the arrangement used at this company's mill. Only two decks or series of tanks are used, but tests have shown that a better saving of dissolved gold and of cyanide could be made with a third series. Each Huntington mill serves two tanks, one is being filled while filtering and sluicing are being carried on in the other. In filling a tank, the pulp passes directly from the mill over amalgamating plates and is run into the tank from side gates in a launder passing over the tank.

The ore is ground in a 2-lb cyanide solution. Lime is added in the feed to the Huntington mill. The use of three pounds of quick lime per ton of ore gives good results. The solution often titrates a little more effective cyanide after passing through the mill and the first series of tanks because of the lime added. Before the tank has its proper charge of pulp, which takes the entire capacity of a 5-ft. Huntington mill for seven or eight hours, the filters will become flooded and an overflow spout or decanting pipe or both carry the excess water and slime to a tank at one side arranged as an overflow tank. This tank can be equipped with filter leaves or not as desired. The overflow when sufficiently clear can be sent direct to the gold-solution sump or pumped up to the battery-feed tank when slimey. The tank should be set sufficiently high so that it can be cleaned by sluicing into the lower series of tanks. No overflow is necessary for the lower series of pulp tanks.

Pulp Sluiced from Tank to Tank

Six to eight hours are necessary for the satisfactory leaching of the upper set of tanks. The sluicing is done by removing the bottom plugs, and by using a long ½-in. pipe, plugged and bored with a ¼-in. hole, for a nozzle. The sluicing can be assisted by a pipe placed along the bottom of the tank with a hole so bored that a jet of water can play on the pulp directly above the discharge gates. An active operator can sluice and clean from 8 to 10 tanks in eight hours. The pulp goes directly to the tank below, just sufficient water being used in the sluicing to fill the tank. This tank in turn when leached down is sluiced into the tank below, when three series of tanks are used in the process. The first sluicing is done with the barren solution from the zinc boxes, the second with clear water or a proportion of clear water and barren solution. Sufficient clear water is added to supply the loss of water used in the system. The last sluicing from the third series of tanks, will be the final tailings discharged and is done with clear water.

During the passage of the pulp through the tanks no cake is formed on the leaves and the mixture of sand and slime is a better filtering medium than might be expected. While sluicing, all clots are broken up and the pulp is thoroughly diluted, agitated and aerated. The above company uses a small amount of wash water in the lower series of tanks by placing the nozzle to the bottom of the tank and thoroughly mixing the pulp. The lower series of tanks leach to 25% moisture before the pulp is discharged. All pulp is under treatment 24 hours.

The extraction and efficiency under the above method is as follows: When the average of the heads is $5 per ton gold, the discharged pulp from the first series of tanks carries approximately $1.50 per ton. The amalgamation in the cyanide solution is unsatisfactory, only about 10% of the total gold being recovered on the plates. The solution hardens the plates and renders them almost of no value for amalgamating after three or four months' run.

The filtrate solution from the first series of tanks carries from 40 to 50c. per ton, and from the last series from 10 to 20c per ton, depending upon the time the sample is taken. The final tails discharged carry from 50 to 60c. per ton, and will titrate a little more than a trace of cyanide. The system requires from 15 to 20 gal. of water per minute for a 100-ton plant. The cyanide consumption amounts to about ½ lb. per ton of ore. The total recovery is from 90 to 92% of the gold content in the ore. The total labor and supply costs, exclusive of power, approximate 47½c. per ton of ore treated.

First Cost Low

The use of the gravity filter leaf here has proven simple and effective. The tank equipment is inexpensive, amounting to about $100 per tank complete. The filter leaves cost to make from $5 to $8 each, depending upon the price of labor and materials available. Their construction is such that they do not become impervious to solutions after several months usage, as is the case with vacuum and pressure filters. The upkeep is reduced to the minimum because of the simple equipment. There are no large capacity sand or slime pumps to maintain or operate, and power costs, no matter where, are always a serious factor to be dealt with in designing a plant.

The quantity of precious opal won in 1911 from the White Cliffs and Lightning Ridge fields in New South Wales was less than in previous years, but some stone of exceptional quality was discovered during the year.

Effect of Sulphur on Firebrick

In the process of building the two new Edwards' roasting furnaces at the Associated mine at Kalgoorlie, states M. W. von Bernewitz, a large number of old bricks from the old furnaces were used, care being exercised in their selection so that only the best were saved. In spite of this, a few, under a dozen, soon showed signs of fretting away. The foreman bricklayer reported that these bad bricks must have come from either the walls in the hot parts of the old furnaces, or from one of the floors. That conclusion was based on the fact that when such bricks were built in, they invariably started to swell and fret away. When this class of brick is stacked outside, and left to the influence of the weather, decomposition is rapid and complete, whole bricks crumbling away to a powder. Bricks from certain parts of the flues also behave in a like manner.

What is the cause of this change? It may be mentioned that bricks laid in lime mortar, fireclay, or ordinary clay are not acted on similarly, so the argument that lime may be partly the cause, will not hold good. The original bricks came from Coolgardie, and were noted for their general hardness, good composition and finish. As these bricks were laid in the hot portion of the furnaces, where most of the sulphur in the ore is eliminated, and the bricks being naturally of a porous nature, the sulphur would gradually tend to saturate them. The iron, alumina and magnesia that exist in the original clay are attacked by the sulphurous acid with the ultimate formation of sulphates. When the bricks are dampened and laid down with water, these sulphates, being deliquescent, take up water, and this results in the swelling and crumbling away of the brick. The same process takes place when the rain soaks into bricks left in the open.

We have broken several samples which were partly decomposed, there being a fairly hard center left, which gave off the characteristic sulphurous odor. New bricks give a slightly alkaline reaction, while the affected bricks are strongly acid. If many of these old bricks were built in a furnace, the results would be disastrous, as the lifting power during swelling is rather extraordinary. From the old Ropp furnaces, which were at work some years ago, a number of bricks were used in building walls before this action was understood, and two of them have fretted away rather badly, while a third has lifted up the sole plate of a building nearly an inch. Of course, decomposition continues only as long as the bricks get moisture. The foregoing observations may put others on their guard in the use of old furnace bricks, especially those bricks that have been exposed to the weather.

Improvements in Crushing Rolls

By C. Q. Payne*

Much progress has been made in coarse and intermediate crushing by increasing the size of the rolls and by making the framework more massive. Rolls for fine crushing have not yet been so satisfactorily improved.

Note—Excerpt from an article entitled "Progress in Roll Crushing," read at the San Francisco meeting of the American Institute of Mining Engineers, October, 1911.

*Mining engineer, 82 Beaver St., New York.

The art of crushing ores and other materials by means of rolls is one of comparatively recent origin. While the first record of the use of rolls with iron crushing surfaces dates back to the year 1806, when they were employed in Cornwall, their principal development has taken place during the last 30 years.

To Stephen R. Krom belongs the credit of being the pioneer in introducing the belted high-speed roll, which was originated and developed in this country. His notable contribution to the art was in the use of a single bedplate or frame for supporting the roll shafts, and to which levers holding the movable roll bearings were pivoted. He also made use of steel tension rods to support the crushing strains, and of hammered-steel tires for the crushing surfaces. These changes brought the design of crushing rolls to an advanced stage.

Following closely thereon, about 1885, W. R. Eckart conceived the idea of the swivel or ball-and-socket support for the roll shaft bearings. This is an excellent mechanical conception, especially for bearings held against a spring pressure, and while it may not be necessary for all types of rolls, yet it has been quite generally adopted by other designers of rolls and illustrates the refinement which roll construction has now reached.

The Edison "Giant" Rolls

Other engineers, as for example, Argall, Vezin, Rogers and Sturtevant, to mention only a few among many, have also given the closest attention to the various details of rolls, such as the frame, springs, bearings and shafts, and have developed many novel and original designs. It has remained, however, for the boldness and originality of Thomas Edison to extend the field of crushing rolls in two directions, and to cause them to exercise new functions. In developing crushing machinery for his portland-cement works, Edison constructed "giant" rolls, having a diameter of 6 ft. and a length of 7 ft. With these he was not only able to challenge the long established position of the jaw and the gyratory crushers as primary crushers, but even to leave them well in the rear. By means of projecting knobs on the roll surfaces, he utilized the stored energy of the revolving rolls, and was able to shatter masses of rock of so huge a size that they could not otherwise be made to enter the rolls, thus saving the expense of block-holing and sledging, which is usually charged to quarrying. This work has had successful applications in crushing limestone, and there remain also possibilities of the extension of this new use of rolls to still harder rock.

In going to the other extreme of size reduction, Edison has also utilized rolls in pulverizing cement rock. For this purpose, rolls with sectional, corrugated chilled-iron shells 30 in. diameter by 18 in. face, are provided with shafts 18 in. diameter. The rolls are forced together with a spring pressure of 100 tons. The feed material, which has passed a ¾-in. screen opening, is thus reduced in a single operation, at the rate of 60 tons per hour, to a size of which 94% passes 100-mesh screen. This use of rolls carries the principle of choke crushing to so extreme a limit as to involve practically a new function. It would appear at first sight, however, that there is less margin of profit for rolls in pulverizing than in mass reduction, and only a close comparison of the final products obtained and the respective costs per ton can determine the relative economy of rolls for pulverizing when compared with the tube mill and other types of grinding apparatus.

Rolls for Coarse Crushing Are Being Made Heavier

Irrespective of the part which rolls may play in the future in their relation to the two extreme limits of size reduction, there is no doubt that they have achieved for themselves a secure position in crushing products of intermediate sizes. This is partly due to their large capacity and low cost of operation. It is also due to the fact of their mechanical simplicity, which involves the principle of the toggle lever in overcoming crushing strains exerted by particles brought within the angle of nip of their surfaces. Since their revolving masses also serve to absorb their own "peak loads" when properly fed, a moderate and fairly uniform application of driving power is able to accomplish a considerable amount of effective work in splitting and shattering rock fragments.

Perhaps the most distinctive advantage of rolls is that their construction permits them to apply the principle of "arrested crushing" to a greater range of sizes than is possible with any other type of crushing apparatus. The crushing pressure exerted by the opposing roll surfaces during the angle of nip is instantly released and ceases when the rock fragments reach the horizontal diameter of the rolls, where the open space between them permits the material to be discharged. Roll crushing thus permits most careful and accurate stage reduction within a wide range of sizes, and avoids pulverizing and sliming an undue amount of the softer minerals of an ore, in crushing it to the size at which they will unlock sufficiently from the inclosing gangue to permit their being concentrated. For those ores, therefore, which require concentration, the use of rolls in preparing them for jigs, shaking tables, or magnetic separators has become almost the universal practice. This applies to many iron, copper, lead and zinc ores. Gold and certain silver ores, both those which require concentration and those which do not, are in a class by themselves.

The modern tendency to reduce milling costs by increasing the mill capacity has demanded a greater duty from rolls than ever before, and in the larger mills rolls are now employed from 36 in. up to 54 in. diameter, and from 15 in. to 28 in. width of face. Such rolls are used mainly for coarse crushing; that is, they take the product from the jaw or the gyratory crusher of 1½- to 2½-in. size, and reduce it to about ½ in. These coarse or No. 1 rolls are then followed by other rolls, set closer together for finer crushing, and possibly by others which recrush certain middlings products obtained in the process of ore treatment, or even tailings, dependent upon the nature of the ore and its association. Rolls of this general character require massive construction and excellent workmanship. Rolled-steel tires can now be obtained up to 54 in. diameter. Special hard steels, such as chrome and manganese steels, are also used for certain ores, either in the form of tires or of plates bolted to a central mandrel. In this way the life of the crushing surfaces has been much prolonged.

Marked progress has thus been made within recent years in the field of coarse crushing by means of rolls, in response to the greater demands of modern mill practice, and this progress has been largely brought about by increasing the dimensions of the rolls and adopting a more massive construction, as well as a better design, combined with a wider choice of steel adapted to different ore requirements than has heretofore been available.

Rolls for Fine Granulation Not Yet Perfected

On the other hand, it must be admitted that up to the present time rolls designed for fine crushing, where the ore requirements demand a maximum granulating effect and a minimum pulverizing or sliming effect upon the crushed product, have made little progress compared with rolls designed for coarse crushing. In fact, rolls, as heretofore designed, can hardly be said to have held their own; and since little assurance of their satisfactory operation can be had in connection with an ore which must be reduced to pass a 20- or 30-mesh screen while retaining the crushed material in a granular condition, rolls have been assailed on all sides by various types of ball mills and other pulverizing apparatus, which claim to accomplish the function of granulating an ore successfully, but usually by means of some reduction in the time during which the pulverizing effect takes place. While there may be an overlapping territory at the limit of fine granulation where pulverizing apparatus may be so adjusted as to perform the function of approximate granulation with sufficient success to make their use advisable, yet it is clear that a crushing force exerted upon material placed between walls which do not touch when at their minimum distance apart, must produce a distinctly better granulated product than when it is crushed between walls which are brought into physical contact with a grinding pressure.

With the presumption of advantage thus on the side of rolls, even down to the finest sizes, the fact remains that heretofore rolls have proved unsatisfactory and inefficient, from lack of control over the granulating action as the roll faces wear, and also from their small capacity.

In looking more closely into the cause of this inefficiency, it is evident that the effect of the irregular wear of the roll faces becomes a more serious matter in fine crushing than in coarse crushing, for the reason that in the former, since the faces must be brought quite close together, the ratio of the sectional area due to irregular wear to the total areal opening between the rolls is greater than in the latter case. Hence any ridging, grooving, or corrugating of the roll faces permits a considerable proportion of the particles in the feed stream which enter the depressions to pass between the rolls without being crushed. This reduces the capacity of the rolls, measured by the amount of undersize or finished product obtained. Another difficulty arising from irregular wear of the roll faces is due to the fact that when out of parallelism rolls tend to exert a certain component of the crushing pressure at right angles to the diameter of the rolls, or in the direction of the axes of their shafts. This produces an end thrust upon the roll shafts, which, transmitted by means of collars to their bearings, causes them to heat and the shafts to cut, thus absorbing power wastefully, and still further reducing the crushing efficiency as measured by the power consumed to operate the rolls in relation to the amount of finished product obtained.

Rolls used for fine crushing thus show a decreasing efficiency in proportion to the wear of their roll faces until a point is reached where it becomes necessary to stop the crushing operation, and to restore the faces by chipping, grinding, or machining them until their surfaces are parallel. This involves loss of time and of mill capacity, besides expense and a wasteful use of the roll shells.

While a certain amount of choke crushing is usually advisable in fine crushing, in order to offset some loss of capacity, the best results can only be obtained, where the prime object is to granulate an ore, when the roll faces are maintained parallel, and when the feed consists of sized material in order to avoid packing and pulverizing it in passing it between the rolls. It seems clear from the above considerations that further advance in the art of fine granulation by means of rolls can only be expected by means of certain refinements of function whereby the roll faces can be maintained parallel while they undergo wear.

Mineral Deposits of Bulgaria

The mineral deposits of Bulgaria at one time played an important part in the industry of the country, but were afterwards abandoned until within the last few years. Recent investigations have revealed the existence of ancient workings dating back to the time of the Romans, some of them having been reopened by the Saxons during the early part of the fourteenth century. In 1879 the Bulgarian government started a lignite mine at Mochino, 17 miles from Sofia, and worked it until 1891, the total output, being consumed in the capital and by the state railway.

The iron industry was formerly carried on at Samakof, where a large heap of slag, containing up to 53% of iron, and capable of utilization as ore, has been discovered. Magnetite is found in compact masses at Srem, but neither this deposit, which is 25 miles from the railway, nor that at Bogitsa has been investigated. The deposits of red hematite at Kremikovtzki, Breznik and Troyan are better deserving of attention, the ore being rich. Two concessions have just been granted.

Manganese ore occurs at Varna, Sliven and Haskovo, and in the first-named district a number of prospecting licenses have been issued, but the investigations are not yet sufficiently advanced to afford any positive information. The ore occurs in a pure state in some places, and as impregnating clay shales in others. One of the deposits, situated near the sea, a fact which invests it with considerable importance, has furnished samples containing up to 40% of manganese.

Graphite is found near the village of Bistritza (Doubnitza district), in a pure state, but has not been worked. Oil-bearing shales, chiefly paraffiniferous, occur in the districts of Bresnik, Philoppopolis and Sliven, but have not been worked. Anthracite is found in the environs of Svogné-Tzaritchina, Tzeretzel, Rebrovo, Svidnya, and Batoulya, all in the district of Iskretz, Department of Sofia, traversed by the Sofia-Varna railway. Several concessions have been granted, according to *Bulletin de la Societe de l'Industrie Minerale,* for the prospecting of these deposits, which occur in greatly disturbed Permo-carboniferous strata, in consequence of which they are difficult to investigate. At the outcrops the anthracite crumbles to dust, and if it is important that further investigations should be made to determine whether a more compact form exists at all. In one case, near Tzaritchina, a concession has been granted to work a seam of anthracite averaging eight feet in thickness.

Coal is found in several places near Sofia, but the most important deposits are met with in the Balkans, at Gabrovo and Trevna where small quantities of coal were raised prior to the Russo-Turkish war, and even down to 1892. The coal was fairly pure and yielded good coke. The deposits are irregular, though typical seams have been identified. One portion of the basin has been reserved by the State, and the rest has been parcelled into a number of prospecting concessions which are being actively investigated.

The "Prince Boris" concession at Trevna contains coal in seams and lenticular beds, and the proprietor of the concession has built a narrow-gage railway, 35 miles long, to connect the coal field with the state railway at Tirnovo station. Lignite is found in considerable quantities, the most important deposit being that owned by the State in the Tertiary basin at Pernik-Mochino, covering an area of about 40 square miles. The mine is equipped with modern French appliances for washing, briquetting and electric lighting.

The Ahmeek Mining Company paid its first dividend, of $2 per share, on Nov. 1, 1911. In January, 1912, it paid a second dividend of $3 per share. There are 50,000 shares issued, of $25 par value.

History of a Once Famous Arizona Gold Mine

SPECIAL CORRESPONDENCE

No matter how often the "bottom drops out" of the copper market, it is not customary for the bottom to drop out of a copper mine. The Rio Tinto, of Spain, has been worked for 2000 years and is producing more copper today than it ever did in the past. Mines like the United Verde, the Copper Queen and the Pilares increase their reserves from year to year. But with gold mines business enterprise often becomes a romance. In rare instances, however, does the man who has followed a yellow streak in the hills to fortune have the luck to abandon the game just as the pay streak fails, but such is the history of the Fortuna mine, which leaped into fame, produced its millions making more than one family rich, then vanished from the mining records of the country like snow on a spring day.

THE FORTUNA MINE AND CYANIDE MILL AT GILA, ARIZ., IN 1897

The Fortuna mine was, not many years ago, the inspiration to every gold seeker in the Southwest. Its discovery was as romantic as its development, its chambers of virgin gold and its sudden passing. In 1892 the gold-placer fields of California were drawing prospectors and fortune hunters across the arid deserts of Arizona. One of the noted stopping places of the caravans was the camp of Gila, about 30 miles southeast of Yuma, on the Mexican border. One evening there drifted into this camp Billy Holbert and his partner. They turned their pack burros loose, and the animals strayed up on the foothills of the west slope of the Gila mountains. Even before this the fortune seekers had discovered gold on the east slope. The precious metal, however, had never been found on the west slope of the mountains. This did not deter the burros that had wandered away from Holbert from going after the green cactus on the shoulder of the hill. Toward evening, so the story goes, Holbert went after the burros. He picked up a piece of rock to throw at the animals, and was on the point of hurling it at the leader when his trained eye caught the glint of gold in the rock. Investigation showed that the ground was literally spotted with gold-bearing rock. The news spread, but not before Holbert and his partner had staked out the ground and made good their title.

DISCOVERERS SELL PROPERTY FOR $150,000

Holbert did not go to California. He had discovered what proved to be one of the great bonanzas of Arizona. When he and his partner had driven an incline shaft into the rock in the hill only 20 ft. the showing in gold was remarkable. The fame of the new strike came to the ears of Charles D. Lane, who organized the Wild Goose company, at Nome, Alas., and who is now largely interested in the Utica mine, at Angels Camp, Cal. Lane formed the Fortuna Mining Company to take over the property, for which he paid $150,000. A mill was erected at once and began operations in April of 1894. The machinery was freighted from Blaizdell, 16 miles distant. A water plant had to be installed also, at a cost of $40,000, the water being pumped 16 miles to the mill. This mill was claimed to have the heaviest stamps in any mill in the world at that time, the stamps weighing 1450 lb. each. The gold was amalgamated and the bars turned out were 960 to 970 fine.

From the first the mine was a bonanza. The cleanup was made every 30 days, and averaged $40,000. Nuggets too coarse to pass through the screen often accumulated in the batteries. The mine established many records, but the most notable was in the size of a bar of bullion for a 30-day run. This bar was sold to the Selby Smelting and Lead Company, at San Francisco, for $97,000. For the transportation of this gold it was necessary to maintain a mounted guard, which accompanied the bars to the railroad station.

PRODUCED $3,000,000 BEFORE OREBODY FAILED

The Fortuna continued to produce gold at the rate of a quarter of a million dollars a year for 12 years. The vein was narrow and difficult to follow. And as it was followed to a depth of 2000 ft. it turned over several times, the hanging-wall more than once becoming the foot-wall. The gold occurred in a schistose formation, which was cut in places by feldspathic dikes. At depth the schist ran into blue syenite, but the dikes continued downward. The irregularities of the orebody made it difficult to follow at all times, but all along Lane's slogan was, "When she doesn't pay, shut her down." He always said that a mine was made to produce metal, and when it ceased doing that it would not bury his fortune, for all its past history and record. He made good his word, for when the orebody was finally lost, he made no effort to locate it, but bade his Ophir farewell, and quit the camp. The camp died with the mine, for notwithstanding the fabulous wealth of the Fortuna, prospecting in the vicinity failed to produce even the semblance of another mine. Today only the remains of the buildings are to be seen. The Fortuna was remarkably free from water so efforts may, at some future time, be made to relocate the orebody.

Separation of Alumina and Ferric Oxide

Barbier describes a new and convenient method for the separation of alumina from ferric oxide (*Bull.* Soc. Chim. de France). The alumina and ferric oxide are separated from other substances in the ordinary way, the precipitate of hydroxides is dissolved in a little acid, and a slight excess of sodium-acetate solution is added, enough to give the solution a red color and to insure absence of free mineral acid. Next a 10 per cent. solution of sodium hydrosulphite is cautiously added until the red color of the ferric compounds has wholly disappeared. The solution is then boiled for a short time, when the whole of the alumina is precipitated as a dense white powder which is easy to filter and wash. The filter paper is moistened with nitric acid and incinerated, and the alumina transferred to the crucible and the whole strongly ignited. In the filtrate the iron can be estimated in any known manner. The author has had occasion to analyze a number of beryls, and he points out that glucinum, when present, is precipitated as hydroxide with the alumina. On prolonged digestion of the precipitate (36 hours) with a cold concentrated solution of ammonium carbonate, the glucina is wholly dissolved. The alumina is then filtered off and the glucina reprecipitated from the filtrate by boiling this for some time.

NEW PUBLICATIONS

The McGraw-Hill Book Co. announces the completion of arrangements for the sales agency of the technical books of the *Railway Age-Gazette, American Engineer* and *Signal Engineer.* This makes the McGraw-Hill Book Co. publishers and distributors of books for the three journals, but it does not affect the publication of the papers themselves in any way. With the addition of these three papers in the railroad field, the McGraw-Hill Book Co. now publishes books for the twelve leading American engineering papers in the fields of mining, civil, mechanical, electrical, metallurgical and chemical engineering, electric and steam railroading and machine tools. The papers now represented are *American Machinist, Engineering News, Electrical World, Railway Age-Gazette, Electric Railway Journal, Power, Engineering Record,* ENGINEERING AND MINING JOURNAL, *Coal Age, Metallurgical and Chemical Engineering, American Engineer* and *Signal Engineer.*

POWER HOUSE DESIGN. By John F. C. Snell. 5¾x9, pp. 448, illus.; $6. Longmans, Green & Co., London, Eng.

THE OFFICIAL YEAR BOOK OF NEW SOUTH WALES, 1909-10. Pp. 634. J. B. Trivett, Government Statistician, New South Wales.

THE USES OF PEAT FOR FUEL AND OTHER PURPOSES. By Charles A. Davis. Pp. 214. Bull. 16, Bureau of Mines, Washington, D. C.

PRACTICAL GEOLOGY AND MINERALOGY. By W. D. Hamman. 5½x7¾, pp. 224, illus.; $2. Way's Pocket Smelter Co., South Pasadena, Calif.

GEOLOGY AND MINERAL RESOURCES OF A PORTION OF FREMONT COUNTY, WYOMING. Pp. 90, illus. C. E. Jamison, State Geologist, Cheyenne.

ANNUAL REPORT OF THE MINING DEPARTMENT OF TENNESSEE FOR 1910. Pp. 155. R. A. Shiflett, Chief Mine Inspector, Nashville, Tenn.

REPORTS ON WIRT, ROANE AND CALHOUN COUNTIES. By Ray V. Hennen. Pp. 573, illus.; $2. West Virginia Geological Survey, Morgantown.

PRELIMINARY REPORT ON THE STRUCTURAL MATERIALS OF OKLAHOMA. Pp. 182, illus. Bull. 5, Oklahoma Geological Survey, Norman, Okla.

MINING LAWS OF AUSTRALIA AND NEW ZEALAND. By Arthur C. Veatch and Walter L. Fisher. Pp. 180. Bull. 505, U. S. Geological Survey, Washington, D. C.

RESUME OF PRODUCER-GAS INVESTIGATIONS, Oct. 1, 1904-June 30, 1910. By R. H. Fernald and C. D. Smith. Pp. 393, illus. Bull. 13, U. S. Bureau of Mines, Washington.

PRODUCTION OF PETROLEUM IN 1910. By David T. Day. Advance Chapter from "Mineral Resources of the United States," 1910. Pp. 136. U. S. Geological Survey, Washington, D. C.

REPORT ON THE GYPSUM DEPOSITS OF THE MARITIME PROVINCES. By William F. Jennison. Pp. 165, paper, illus. with maps. Canadian Department of Mines, Mines Branch, Ottawa.

GEOLOGY OF A PORTION OF FABRE TOWNSHIP, PONTIAC COUNTY, QUEBEC. By Robert Harvie. Pp. 33, illus. Dept. of Colonization, Mines and Fisheries, Mines Branch, Quebec, Canada.

REPORT OF PROCEEDINGS OF THE AMERICAN MINING CONGRESS, 1911. Fourteenth Annual Session, Chicago, Ill., Oct. 24-28. 6x9, pp. 397, paper. Published at the office of the secretary, Denver, Colo.

MEXICO; A GENERAL SKETCH. 6½x9½, pp. 409, illus. Compiled by the Pan-American Union, Washington, D. C., June, 1911.

This book is recommended to anyone who wishes a comprehensive handbook bearing on every side of Mexican progress.

GRAPHICAL SOLUTION OF FAULT PROBLEMS. By C. F. Tolman, Jr. 5½x8, pp. 43, illus.; $1. Mining and Scientific Press, San Francisco, Calif.

Contents: Nomenclature of fault movement; methods of projection; elementary problems in line and plane intersections; fault movements of pure translation—fault plane vertical; fault movement of pure translation—fault plane inclined; fault problems where a rotation about a pole is combined with translatory movement.

REPORT OF THE MOLYBDENUM ORES OF CANADA. By T. L. Walker. 9¾x6½, pp. 64; illus. Canadian Department of Mines, Mines Branch, Government Printing Bureau, Ottawa, 1911.

This report aims to present all the available information regarding molybdenum deposits in Canada, with the view of arousing interest in their economic possibilities. A list of the most promising of these deposits in Nova Scotia, New Brunswick, Quebec, Ontario and British Columbia is given.

MINING WITHOUT TIMBER. By R. B. Brinsmade. 6x9, pp. 309, illus.; $3. McGraw-Hill Book Co., New York.

The scope of this book is adequately indicated by its title. Its subject matter is essentially based upon the contributions to recent periodical technical literature. Although incomplete and imperfect in its treatment, and in no sense analytical and critical, it is nevertheless a useful collection, giving to the reader a good deal of valuable information that otherwise he cannot so conveniently obtain and much that he would be likely to miss.

A MANUAL OF THE AMERICAN MINING LAW. By A. H. Ricketts. 4½x6¾, pp. 500. Scientific Book Publishing Co., San Francisco, Calif.

The body of this book consists of a digest of the federal and state laws applying to the mining business. The headings are: Mining law in the United States; courts; actions; grubstake contracts; mining partnerships; co-tenants; mining leases and licenses; options, deeds, examination of title; possession, abandonment, forfeiture; remedies; miscellaneous definitions; coal lands; lode claims; mill sites; placer claims; timber lands; town sites; tunnel sites; water rights; monuments; discovery; locators and locations; annual expenditure; patents, and taxation. The definitions are simple, and citations full. There is a helpful appendix of forms and methods of proceeding in mining law, and a good index, both by subject and case.

A BRIEF LABORATORY GUIDE FOR QUALITATIVE ANALYSIS. By Arthur E. Hill. 5½x7, pp. 80. Chemical Publishing Co., Easton, Penn.

We believe there is too much simplicity aimed at in this book. There is no royal road to learning, and ignoring the effects of borates and phosphates does not alter the results when solutions of borates and phosphates are treated. Nor will leaving out consideration of cadmium prevent a beautiful yellow sulphide making trouble for the youthful analyst some day, if he stir at all outside of mixtures made by a thoughtful teacher. Then the student, at considerable effort, will have to put a few pergolas on his knowledge of qualitative analysis. We believe the student will not be seriously damaged by having to think, and that the textbooks on qualitative analysis, even when elementary, should be complete as far as they go. The student can learn as much manipulation, and about as much chemistry, if he learn the first three groups completely, as if he ignore all the troubles chemical flesh is heir to, and learns to detect all the groups, providing no chemical derelict is floating around to wreck him.

COURS DE METALLURGIE DES METAUX AUTRES QUE LE FER. By Eug. Prost. Pu. 888, illus. Ch. Béranger, Paris and Liége.

This elaborate work, the most recent general treatise on metallurgy, we make haste to say is a good one. This was, of course, to be expected as the product of so accomplished a metallurgist as Prof. Prost, who is well known by his work at the University of Liége. In the present treatise he begins with zinc, following with lead, silver, gold, copper and tin. The amount of space devoted to each of these subjects permits of a comprehensive and well-balanced treatise on each. That upon zinc is particularly strong, which, of course, is natural in a book emanating from a historic center of the zinc industry. Prof. Prost's treatment of this subject is competent, illuminating and satisfactory. Moreover, it is distinctly uptodate. The last may be said of the other subjects treated in this book, Prof. Prost being evidently a careful reader of the JOURNAL and thereby keeping abreast of the progress in the art of metallurgy.

A unique and valuable feature of this book is its inclusion of the metallurgy of the less important metals. Thus are to be found sections on cadmium, nickel, cobalt, mercury, antimony, bismuth, aluminum, platinum, manganese, chromium, tungsten, molybdenum, titanium and vanadium. In no case do these chapters appear to be merely perfunctory compilations. It is useful to find them collected in one volume.

Prof. Prost, in his preface, expresses gracefully his recognition of the eminence of American metallurgists, and the great advancement in the art that is due to them. We have pleasure in returning the compliment with praise for the excellent summary of their work that he has given us.

PERSONAL

Mining and metallurgical engineers are invited to keep THE ENGINEERING AND MINING JOURNAL informed of their movements and appointments.

L. D. Huntoon is directing development work at the Alice Dayton mine, near Wentworth, Missouri.

Edwin S. Berry will leave New York this week for Chile to make an inspection of the Braden Copper Co.'s property.

J. H. Plummer, president of the Dominion Steel Corporation, has sailed for England, where he will remain for two months.

James McNaughton, general manager of the Calumet & Hecla Mining Co., has returned to Calumet, Mich., from a short visit in the East.

Jack S. Wilson, formerly of Marquette, Mich., but now of Porcupine, Ont., has been chosen a director of the Dome Mines Co., of Porcupine.

Charles M. Henrotin, formerly connected with the Kimberley diamond mines, has been put in charge of underground work at the Dome, Porcupine, Ontario.

Robert Livermore has taken charge of the Kerr Lake Mining Co., Cobalt, Ont. He is son of Col. Thomas L. Livermore, formerly vice-president of the Calumet & Hecla.

Dwight E. Woodbridge, of Duluth, is in Birmingham, Ala., and expects to be in the South for some time, on professional business connected with the United States government.

Arthur Scott, formerly superintendent of the Calumet mine, in the Metropolitan district, for Pickands, Mather & Co., has been appointed superintendent, under W. G. Hansen.

W. S. Keith, manager of Frankmont Mining Co., has returned to San Francisco, after a two months' stay at the company's property at Last Chance, in Placer County, California.

J. W. Pender, of El Paso, Tex., has been in Pittsburg several weeks, and has now gone to take charge of development on the Penn-Sonora mine, north of the Altar district, Sonora, Mexico.

Capt H. T. Munn, who has been in charge of operations on the claims of the Porcupine Canada Mining & Development Co., owned in London, has gone to England to report the result of operations.

A. W. Prior, who recently resigned as resident manager of the Rio Plata Mining Co., in Chihuahua, Mexico, is now in Los Angeles, Calif. Alvin R. Kenny, formerly mine superintendent, has succeeded Mr. Prior.

W. H. Foster, until recently assistant manager of the smelting department of the Guggenheim interests in Mexico, has accepted a position in the buying department of the Continental Mexican Rubber Co. Mr. Foster for several years was located at Asarca smeltery.

A. C. Veatch, having returned from a year's examinations and explorations in the Trinidad and Venezuela oil fields, and having resigned from the U. S. Geological Survey, announces that he will practice as a consulting geologist, specializing in oil, with office in Washington.

W. G. Hansen, formerly assistant superintendent of the Verona Mining Co., has been appointed superintendent of the Iron River-Stambaugh district, Menominee Range, for this Pickands-Mather subsidiary, to succeed W. H. Jobe, who resigned to become general manager of the Iron River Steel Co.

Samuel S. Arentz, superintendent of the Nevada Douglas Copper Co. for the past four years, has been appointed general superintendent of the company and of the Nevada Copper Belt R.R., with headquarters at Ludwig, Nev. Archie J. Orem becomes superintendent of the Nevada Douglas company.

OBITUARY

John Herron died at Telluride, Colo., Feb. 3, from injuries caused by a falling timber which struck him as he was climbing a ladder between two levels in his mine. He was 55 years old, and had been for a number of years prominent in mining in Colorado. He was for several years general manager of the Tomboy Gold Mines, Ltd., and at the time of his death was manager of the Telluride Leasing Co., operating on the Smuggler-Union and other mines. He left a widow and three children. His brother, D. A. Herron, is the present manager of the Tomboy.

George Jarvis Brush, professor emeritus at the Sheffield Scientific School, Yale, died at New Haven, Conn., Jan. 6, aged 80 years. Prof. Brush was a mineralogist who had written extensively on many phases of geology, and was a member of most of the great scientific sccieties of the world. He studied under Yale's famous professor of sciences, Benjamin Silliman. He was graduated from Yale in 1852, and after a year in the University of Virginia and two years' study in Europe he was called to Yale and the newly formed Sheffield Scientific School. He became professor emeritus in 1898. Prof. Brush was born in Brooklyn in 1831, the son of Jarvis Brush. He attended private schools to prepare for college. He was a close friend of Joseph Earl Sheffield, who in 1904 gave a large sum of money to the school bearing his name. Prof. Brush gave to the school recently his collection of minerals, and a fund of $10,000 for its maintenance. At the time of his death he was president of the board of directors of the school. He was married in 1864 to Harriet Silliman Trumbull. Three daughters survive him.

Societies and Technical Schools

Institution of Mining and Metallurgy of Great Britain—This society has awarded gold medals as follows: Gold medal of the institution (two awards): (*a*) to E. P. Mathewson, general manager of the Anaconda Copper Co., in recognition of his services in the advancement of metallurgy generally, and especially in regard to copper; (*b*) to Walter McDermott, in recognition of his services in the equipment of the Bessemer Laboratory of the Royal School of Mines, and to signalize his services in the advancement of metallurgical practice. The Consolidated Gold Fields of South Africa gold medal to Walford R. Dowling, for his paper on "The Amalgamation of Gold in Banket Ore."

Canadian Mining Institute—The provisional program for the annual meeting at Toronto is as follows: Wednesday, Mar. 6, at 10 a.m., business meeting, at which the usual current business will be dispatched, the presidential address delivered, and the mineral statistics for 1911 presented. In the afternoon there will be a meeting for reading and discussion of papers; and in the evening Dr. W. H. Tolman, director of the American Museum of Safety, will deliver an illustrated address on "Accident Prevention." On Mar. 7 there will be morning and afternoon sessions for reading and discussion of papers, and in the evening a smoking concert. On Mar. 8, morning and afternoon sessions for reading and discussion of papers, and for the dispatch of any unfinished business will be held. In the evening the meeting will close with the annual dinner.

American Institute of Mining Engineers—A circular from the committee of arrangements says: "At meetings of the Institute in former years the social side was brought prominently to the front; the dinner for the members and their ladies as guests was one of the most attractive features. In recent years this custom has been neglected and many think it has not been to the advantage of the Institute. It is proposed now that the February meeting each year, which has recently been only a business meeting, shall be made a regular meeting, to include not only the discussion of papers but to enable the members to meet each other informally and promote the social side of the Institute as well. To this end, there will be an informal social meeting and smoker for members only at the Institute rooms on the evening of Feb. 19; to be followed on the evening of Feb. 20 by a subscription dinner, for members and guests, at the Plaza Hotel. The reception will be in the palm room of the Plaza at 6:30 p.m., so that the dinner may begin promptly at 7 o'clock. The price of the tickets for the dinner has been fixed at $5 for each person."

Editorial Correspondence

From our Representatives at Important Mining Centers

San Francisco

Feb. 7—Interest in the advancement of mining on the Mother Lode, California, has been so directly centered in Amador County in the present season, that other counties having part in the general movement have been overlooked in the measurement of activity and consideration of the effect upon the future. Calaveras and Tuolumne Counties are adding much to the composite prosperity and have attracted small attention from outside. Although supplied with railway facilities, the chief towns forming the centers of mining advancement in these counties are at the end of the respective lines of road. Jamestown is the terminus of the main line of the Sierra Ry., and Tuolumne and Angels are at the end of the branch roads that form part of the Sierra Ry. system. This situation is a commercial disadvantage to these towns in their relation to other towns beyond the end of the line; but the direct benefit of rail connection with San Francisco and Stockton, the chief commercial centers for these camps, is unquestioned.

Rail transportation has had a noticeable effect upon the development and operation of the mines in providing a market for the concentrates produced by the stamp mills. In 1911 there were shipped from Angels camp 5100 tons of concentrates; 8400 tons were shipped from Jamestown. The latter figure includes shipments from mines other than those immediately adjacent to Jamestown. The grade varies from $30 to $75 per ton. The total value of the shipment of 13,500 tons of concentrates from the two counties is conservatively estimated at $600,000. This output represents the concentrates from approximately 600 stamps. During a part of the last half of 1911 a number of these stamps were hung up for lack of power owing to the freezing of the water supplying the mills at Angels with water and electric power. The figures here given are not assumed to be precise either as to the total value of the concentrates or the number of stamps in continuous operation. The value is probably underestimated, while the stamps may have totaled a smaller figure. But the tonnage is accurate as shown by the railway records.

The prospective future of the camps mentioned is marked by various installations of additional stamps, and other equipment necessary to advanced methods of treatment, and the installation of new machinery to facilitate extraction and the progressive development of orebodies.

In other seasons there has been a disposition to abandon the Mother Lode for fresher fields in Nevada and Arizona. Many of the men who went away in search of opportunities to develop larger mines have returned, and others have joined them. There is, at present, a surer indication of permanency of operation than in the past. The fact that the average milling grade of the Mother Lode ores is low, necessitates improved methods that will guarantee high extraction and the employment of modern and economic methods of treatment. There is a noticeable advancement in milling practice, and the later practice includes the testing of offered improvements in concentrating machinery. Altogether the forward movement of gold mining and milling in Calaveras and Tuolumne Counties is satisfactory.

Butte

Feb. 7—President Thayer, of the Anaconda company, who has been in Butte for several weeks on his semiannual inspection of the company's mines, expressed himself as highly satisfied with the condition of the mining properties in Butte and the prosperous air of the camp. He stated that the mines are being operated on the normal basis of production of about 26,000,000 lb. of copper per month, or 300,000,000 lb. per year, and that production will be maintained at that level without further attempt to increase it. With mining operations carried on in the future at this rate, the reserves in the Butte mines will continue the city's prosperity for many years; also, the electrification of the Butte, Anaconda & Pacific R.R. and the extension of the line into the Georgetown mining district, thus opening the mines of the Southern Cross section, will be of great benefit both to Butte and to Anaconda.

The total production of copper from the Butte district was about 27,500,000 lb. during January; of this amount the output of the Washoe smeltery at Anaconda and the Great Falls smeltery, which includes the production of the Anaconda, North Butte and Tuolumne company's mines, was 26,350,000 lb. About 1,000,000 lb. were produced by the East Butte company, and the remainder consisted of custom ore from the Alex Scott, Butte Central and other small producers. The production of the district during December was about 25,400,000 lb., and in November, 21,850,000 lb., showing the increase in production in the last few months.

According to the report of T. B. Miller, head of the government assay office in Helena, Lewis and Clark County led all others in the production of gold and silver during January, with deposits amounting to $67,931, a great increase over a year ago when the amount for the same month was $20,764. The other counties in the state which made deposits are: Beaverhead, $123; Fergus, $12,896; Granite, $98; Jefferson, $123; Madison, $36,286; Powell, $254, and $762 from Silver Bow.

Denver

Feb. 9—The whole state is worked up over the proposed tariff reduction on zinc, lead and tungsten, and will apparently be backed up by Idaho and other Western states. R. Kenehan, president of the Colorado Mining & Metallurgic Association, requested Senator Guggenheim recently to have the hearing on the metal schedules postponed until after a meeting of the association called for Feb. 13, and the Northwest Mining Commission meeting, at Spokane, Wash., Feb. 15 to 17. It is expected that important action will be taken at these meetings. The Denver Chamber of Commerce has two delegates *en route* to Washington, to argue for a retention of the present duties.

Mining men of Colorado received word recently from the Interstate Commerce Commission that it had approved the proposal of the railroads to increase their freight rate 50c. per ton on Colorado ore shipped to Kansas and Oklahoma points. Some time ago the railroads served notice upon ore shippers that they would raise the rate beginning Feb. 5, and the shippers appealed to the commission for a hearing. Evidently the commission decided that the rate should be advanced without a hearing.

Salt Lake City

Feb. 8—The Utah Apex report for December shows an increase in net earnings. The total receipts were $53,615, from which after deducting smelting and freight charges of $12,436, and mining, milling and development charges of $17,083, left a net profit for the month of $24,095. The last annual report showed net profits for six months averaging $20,616 per month. The output is being in-

creased, and the January production will be in excess of that for December. The present work is opening new tonnage and putting more ore in sight than is being extracted. The limits of the large silver-lead orebody are still undetermined.

The number of furnaces smelting ore in the Salt Lake valley and vicinity at the beginning of February was as follows: The United States Smelting, Refining & Mining Co. at Midvale was running five furnaces on lead ore, and treating its usual tonnage. The wet concentrator is treating between 300 and 350 tons of ore per day, and producing about 45 tons of zinc middlings, which are treated by the Huff electrostatic plant. The American Smelting & Refining Co., at Murray, had five lead furnaces and one furnace on matte concentration in operation. This company is receiving more sulphide ores than there are facilities for roasting under present arrangements, and has stockpiled between 40,000 and 50,000 tons of ore largely unoxidized. The Garfield smeltery of the American Smelting & Refining Co. is running two blast furnaces and five reverberatories, and is smelting about 2200 tons of ore per day.

At the International company's Tooele plant, three reverberatories are treating more than 600 tons of copper ore per day. The greater part of this comes from the Utah Consolidated, from which lead ores also are being received. Copper ores from the South Utah and custom ores are also being treated. The two new lead furnaces are nearly completed, and one of them will probably be ready to begin operations before the end of February, and the other in March. The International has contracted for ore up to the capacity of the lead plant, and is now not so much disposed to get ore under any terms, as formerly.

Duluth

Feb. 9—It is believed here that the opening of navigation in Lake Superior will be the latest in years. The ice in the lake is exceptionally heavy. The average opening of the navigation season is about Apr. 20, but it is believed that the ice problem will delay the free movement of interlake boats until at least May 15.

On the Mesabi range, the long-talked of electric railway seems to be nearer realization that at any previous time. It is reported from Boston that a syndicate headed by Tucker, Anthony & Co. and including Charles D. Barney & Co., of New York, has underwritten securities of the Mesaba Ry. Co., recently organized to build a high-speed, interurban road on the Mesaba range in Minnesota, operating between the towns of Hibbing and Gilbert. The new road will serve six towns which are at present without traction facilities. The company will have an initial issue of $1,000,000 first-mortgage, 5% bonds, $500,000 preferred and $1,500,000 common stock. Construction work on the new line will start soon. Rights-of-way are reported to have been secured at a low figure.

The Cuyuna Range will probably have more shipping mines this season than in 1911, but it is hardly likely that the number of such mines will be as large as many freely predict. While the region adjacent to the towns of Crosby and Ironton still continues to attract attention, more interest than formerly is being taken in the development on the so called south range, particularly in the vicinity of the Adams mine, the latter being a short distance southwest of Deerwood. The Inland Steel Co.'s Thompson mine will probably ship this season and an increased tonnage is expected from the Kennedy mine of the Rogers-Brown Ore Co. The two last-named properties are on the north range.

Negaunee, Mich.

Feb. 9—The Cascade district, situated six miles southeast of Negaunee and classed as part of the Marquette Range, is becoming active. At the New Volunteer mine, owned by T. F. Cole, of Duluth, and associates, about 180 men are employed and a soft, high-grade bessemer ore is being mined. Just southeast of the village of Palmer, a Minneapolis exploring company has begun diamond-drilling. The E. J. Longyear Co. is doing this work under the direction of L. D. Cooper, chief engineer; one drill is in operation and two more are on the ground. The company has options on a considerable tract of land including the holdings of the Pittsburg & Lake Superior Iron Co. In the swamp on Sec. 26, three miles east of Palmer, the Cole & McDonald Exploration Co. is drilling for the Heidelbach interests of New York and the timber is being cut from seven forties held by the Heidelbachs.

The Iron River Steel Co., recently organized in Iron River, has taken over the holdings of the Michigan Iron Mining Co. and the Lennox mine, of the Brule Mining Co. The Michigan Iron Mining Co.'s lands include a 40-acre tract lying just north of the Lennox mine and a 40-acre tract known as the Corry exploration, where the ore formation exists, situated just east of the Berkshire mine of the Brule Mining Co. The Lennox mine, consisting of 40 acres, has a shaft and some underground workings, with 65,000 tons of ore reported blocked out; the Lennox orebody lies between the Dober mine, of the Oliver Iron Mining Co., and the Tully mine, of the Corrigan, McKinney company. The Caspian mine, of the Pickands-Mather company, adjoins it on the southeast. The surface plant and machinery at the Lennox were purchased, and it is reported that ore will be shipped as soon as possible. W. H. Jobe is general manager of the Iron River Steel Company.

Cobalt

Feb. 9—An interesting announcement has been made to the effect that the control of the Kerr Lake mine has passed from the hands of the Lewisohns to the Mines Finance Co. Some time ago this company also obtained the control of the Wettlaufer from the Lewisohns, who are now definitely out of the Ontario mining field.

The La Rose directors are to meet in Montreal soon to decide what is to be done with the $1,600,000 surplus. President McGibbon has promised that something will be done to give the stockholders a larger share of the profits. Personally he favored a plan for redeeming the shares, but was forced to abandon it on account of legal difficulties.

Porcupine

Feb. 9—Particular interest in the Porcupine mining district attaches to the Dome mine. This property is in the most advanced stage of development of any in the camp, and if no unforeseen accident happens, should be in a position to commence operations by Mar. 20. In order to handle the large tonnage above the 45-ft. level, without interfering with the development, an incline is being put down from the crusher station to the level and all the ore can be hauled up on an easy grade. By this means the main shaft can be used for development purposes only, and all the other shafts and raises will be used as ore chutes. The mill is now completely covered and the inside work is progressing rapidly.

Chihuahua

Feb. 5—The movement of ore throughout the state in general is regarded as satisfactory and a tendency toward increased shipments has been noticed. Good business is reported by ore buyers on 3- to 6-months' contracts. The advance in silver and copper metal prices has had a stimulating effect that will probably be felt for some time.

A number of excellent strikes of high-grade ore are reported from the vicinity of Batopilas and these have been reflected in increased activity at a number of nearby inoperative properties. It is believed locally that the ultimate result will be the devoting of more time and money to development and exploratory work. The Cusihuiriachic district is continuing to attract much attention and developments there are reported to be satisfactory. Political troubles are causing some anxiety but it is generally believed among the local mining men that the government will be able to cope successfully with the situation. Up to the present, no effect is noticeable in the mining industry in this district.

The Mining News

The Current History of Mining

Alaska

More recent dispatches regarding the strikes reported some time ago in the vicinity of Sixtymile River, southwest of Dawson, indicate that excitement still continues and claims are being staked rapidly. The gold is said to average $1 per square foot of bedrock, which is about 20 ft. deep. The valley in which the discovery was made is about 20 miles long and 2000 ft. wide.

Copper Mount—R. L. Kilpatrick, representing Duluth, Minn., men who recently purchased this property, is making an examination of the land and will formulate a plan for developing and operating the property.

Londevan—A tunnel that has been driving for several months recently cut the ore at a depth of about 2000 ft. The ore is silver-lead, with copper and gold, and the disclosure in the tunnel indicates a large tonnage above this point. The showing is especially noteworthy, as it suggests the possibility of depth in the Ketchikan district, which has long been doubted.

Redwing—R. W. Dwyer, superintendent of this mine on the west coast of Prince Edward Island, states that the property is showing up well, and that a shipment of ore will be made soon to the Tacoma smeltery. New machinery, including a pump, has been installed, and the coming season is expected to be a profitable one.

Alaska Treadwell—During December, the mills crushed 75,264 tons of ore, yielding $187,904 gross and net $78,629. Operating expenses were $95,201; construction, $14,073; yield per ton, $2.52. Development work amounted to 959 feet.

Arizona

Gila County

Miami—The starting of the sixth unit of the concentrator is still delayed by the nonarrival of the Hardinge mills, which will follow the rolls in that unit. With this exception everything is in readiness for operation. Development on the 570-ft. level is being pushed forward. Where the crosscut from the main shaft cut the orebody, the ore is reported to assay 4.76% copper. One churn drill is at work near the old No. 3 shaft, and has not yet passed through the capping of iron-stained silicified schist.

Inspiration Consolidated—The construction and development plans of the Inspiration Consolidated are still hanging fire. The greatest obstacle to the final settlement of these plans seems to be the inability of the officials of the Arizona Eastern railroad to come to an agreement with property owners along the proposed right-of-way for the extension of the railroad from its present terminus at the town of Miami to the Inspiration and Live Oak mines, a distance of about 1½ miles. In the condemnation proceedings recently instituted in the territorial district court, at Globe, by the railroad company, the court decided that the company must give a bond of $13,500 before it could proceed with construction. This the company declined to do, and rather than take the chance of an excessive award by a jury when the case shall have to come to trial in the new state court, the railroad is now conducting negotiations with the property owners outside of court. W. H. Aldridge, managing director, is now at the mines.

Old Dominion—The output of the smeltery for January was 2,026,000 lb. of fine copper. The company is planning to install skips for hoisting ore. This will include a remodeling of the crushing plant and sampling mill. Some changes will be made in the concentrator, which will increase its capacity to 700 tons per day. At the smeltery a separate dust chamber will be constructed for the converters, and a machine installed for cheap handling of converter slag, all of which will be resmelted. The Gray shaft, of the United Globe, is shut down for retimbering, and the work of concreting the Kingdon shaft is progressing satisfactorily. The company now has about 900 men in its employ.

Copper Reef—At the annual meeting of the shareholders, in Globe, Feb. 5, the board of directors was reëlected, with the exception of J. W. Gillingham, who was succeeded by W. A. Griffith, of Pittsburg, Penn. M. J. Kennedy, of Scottdale, Penn., was reëlected president at a meeting of the directors, and W. A. Griffith was made secretary. Charles Saxman was elected manager, succeeding John W. Gillingham, whose contract expires Mar. 1. The property consists of 80 claims, about 12 miles south of San Carlos, reported to have favorable surface showings of copper.

Live Oak—Excavation is completed for foundations for the new hoist at No. 2 shaft, and preparations are being made to enlarge the shaft to three compartments, after which it will be used for the further development of the orebody. An Ingersoll-Rand compressor, capacity 1300 cu.ft. of free air per min., has been ordered. The eastern end of the orebody is being developed from No. 1 shaft.

Barney—The churn-drill hole is now over 600 ft. deep and is continuing steadily. The hole is in the schist formation and ore has not yet been encountered.

Black Warrior—P. S. Tate and Abraham Lyle are leasing on the 100-ft. level of this mine. The company has sold its teams and store supplies.

Arizona Commercial—The Copper Hill shaft is being retimbered, preparatory to starting development work after the bonds of the old company have been foreclosed and the new company has taken possession.

South Live Oak—This company has been formed to develop the Schulze group of claims, lying a mile southwest of the Live Oak.

Superior & Boston—The crosscut from the McGaw shaft, on the 15th level, is breasted in hard diabase formation after passing through about 15 ft. of badly broken, iron-stained diabase. A stringer of chalcopyrite ore was encountered in this broken formation, and drifting disclosed a width as great as 4 ft. in one place, but the country is so badly fractured and broken up that it is impossible to give an average width and assay for the vein. It is thought that this is the Great Eastern vein and that the drift, which is now in about 20 ft. west from the crosscut, will soon leave the faulted zone and enter the unbroken vein. Assays of some of the ore are reported to run as high as 15% copper.

Southwestern Miami—At the annual meeting in Globe, on Feb. 12, the following officers were elected: George F. Ruez, broker and banker, Ishpeming, Mich., president; R. T. McKeever, president Copper Range R.R., vice-president; Robert H. Gross, president East Butte company, secretary and treasurer. These with the following constitute the board of directors: Thomas S. Dee, of Paine, Webber & Co.; D. T. Kennedy, Boston; G. J. Maas, Negaunee, Mich., and Henry B. Hovland, former president of Live Oak, and now a director of Inspiration Consolidated. The company holds under option 261 acres adjoining Live Oak; the purchase price was about $160,000 upon which $15,000 have been paid. The next

payment of $34,000 is due in June, 1913, and the final payment of $58,000 is due July, 1914. The recent sale of stock to Eastern men is said to have placed the property on a better financial basis and increased operations are contemplated, including more extensive drilling and the sinking of a shaft near the Live Oak property.

GRAHAM COUNTY

Arizona Copper Co.—The January production was 3,200,000 lb. of copper.

California

AMADOR COUNTY

Keystone—The new electrically driven compressor is ready for installation. The repair timbering in the shaft is extra strong and in heavy places the turbines are 19 ft. long, and 18x18 in. in section.

Alpine—This mine is advertised to be sold at sheriff sale on Feb. 24 to satisfy judgment for a small sum. The matter may be adjusted without dismantling the machinery.

Lincoln—The suit to quiet title to the Stewart claim has been decided in favor of the operating company against the California Consolidated. The Lincoln can now explore the east holdings.

Bunker Hill—On Feb. 7, 68 miners were imprisoned in the shaft for 24 hours, through the breaking of a timber by a falling skip. The hoisting cable parted as the skip was dumping. Food and water were sent down in bullion bags through the 4-in. column pipe, and all were rescued without injury.

CALAVERAS COUNTY

Utica—Extraction of ore from the Cross shaft was resumed Feb. 1, and the 60-stamp Stickels mill started. The shutdown resulted from the freezing of the ditches of the Utica power system. One hundred stamps are now dropping on ores mined by this company, including the Gold Cliff mill. F. J. Martin is manager.

North Star—The 10 additional stamps installed in January are dropping, making a total of 40 stamps crushing ore at this mine which is less than two years old. The inclined shaft is 500 ft. deep, and drifting is in progress on the four levels. The Dolling Gold Mining Co. is the owner and G. S. Berry is superintendent in charge.

Angels—Twenty of the 40 stamps are dropping on good ore. The shaft is 1100 ft. in vertical depth. Extraction is from the 225-ft. winze at the 900-ft. level

Lightner—The Supreme Court has denied the rehearing of this company's suit against the Utica. The plaintiff is the former owner of the Lightner mine. The present owner is the Lightner Gold Mining Company.

FRESNO COUNTY

Consolidated Lands & Oil Co.—It is reported that this company, which represents the W. P. Hammon interests, has agreed to the payment of $20,000 for further extension of the option on the Lucile Oil Co.'s property.

MODOC COUNTY

Modoc—This company is reported to have been successfully financed by William Wrigley, Jr., of Chicago, and work started on the property in the Highgrade district.

Sunshine—This mine, which has produced some high-grade ore, is reported to have been sold to F. Wesendanger, of Los Angeles.

Big Four—Negotiations for the sale of this property are reported as being nearly closed.

SAN BERNARDINO COUNTY

Death Valley Arcavalda Consolidated—The litigation is reported to have been settled; 40 men are at work and 20 teams of horses and supplies have been sent to the property near Cima. The plant includes a stamp mill, water equipment and electric lighting system.

SHASTA COUNTY

Noble Electric Steel—The electric smeltery at Heroult made its largest experimental run on Feb. 3, producing 36 tons of pig iron. The furnace was blown in on Jan. 31, and in the 3-days run the total output was nearly 100 tons. The furnace will be operated continuously for two or three weeks for a test run and observations as to cost of operation.

Mammoth—The company is reported to be preparing for an increased production. The orebody opened a year ago is said to have added materially to reserves. Preliminary work has started on the installation of another bank of cooling pipes in the baghouse, making a total of nine. It is expected that this will enable the operation of three instead of two furnaces, as at present. This should increase production considerably.

SIERRA COUNTY

Kate Hardy—A contract has been let for 150 ft. of tunnel at this mine, near Forest, and work will begin soon.

Rainbow—Machinery for sinking at this mine, at Alleghany, is being brought in and installed. L. P. Woodbury is superintendent.

Sixteen-to-One—At this mine, at Alleghany, sinking will begin as soon as machinery, now on the ground, can be placed in operation. W. I. Smart is superintendent.

SISKIYOU COUNTY

Siskiyou Mines Co.—It is expected that the flumes and ditches of this company will be in shape by April to begin active operation. G. B. Burbank, of New York, one of the owners, recently inspected the work.

TRINITY COUNTY

Porphyry Dyke—A cannon-ball mill was installed last autumn and is now in working order for the testing of ore in development, in order to decide upon future equipment. The veins and seams are in a porphyry dike 100 to 400 ft. wide, and of low grade.

TUOLUMNE COUNTY

App—The examination and negotiations respecting the sale of this property include the Moore mine in Amador County as well as the Rawhide in Tuolumne. Captain Nevills states that he is ready to transfer the property, should the prospective purchasers decide to take the mines. The Moore abstracts are now being examined.

Colorado

CRIPPLE CREEK DISTRICT

Rumors are current that a cyanide mill will be put on the Dante in the spring by Edwin Gaylord, one on the Cresson, in Eclipse Gulch, and one on the Elkton, on Raven Hill. The camp is anxious for an official statement of saving and costs on the Clancy mill at the Ajax mine.

South Burns—The January output from this mine on Bull Hill was 13 cars of ore running from $8 to $40. The installation of a new hoist at this shaft has been a boon to the sublessees, most of whom are working in good ore. Charles Crowder is the manager of this property, and also of the Riqua-Savage, where the shaft is being sunk to the 700 level, where a drift will be started.

Trilby—Thirty-two cars of mill ore were shipped in January by the lessees, Oleson and Van Tilborg.

Los Angeles—The January output by Chilson & Polly, lessees, was 14 cars, and it is reported that one car of extra high-grade ore brought $5000. A crosscut is being driven from the end of a drift on the 475-ft. level, and good ore is being mined on the 225-ft. level.

Ajax—The January output was 50 cars of about 1-oz. gold ore. Judge Colburn, president, cancelled four leases for alleged bad mining.

El Paso Extension—The Camilla shaft, on Guyot Hill, has been sunk to a depth of between 900 and 1000 feet.

Lady Campbell—A strike of 2 ft. of rich ore is reported on the Emma Abbott, on Ironclad Hill. Fitzmorris & Bay are the lessees.

Pride of Cripple Creek—Thirty tons have been shipped from the recent strike in one of the Forest Queen flat veins, and it is stated that the grade of the ore was $300 per ton.

Forest Queen—The January output by John Connor, lessee, was about 15 cars,

running $40 per ton. It is claimed that he has sufficient ore in sight for a year's production.

Cresson—The January output was 1600 tons of $25 ore. Richard Roelofs is manager.

Christmas Gold Mining Co.—This company, whose mine is on Bull Hill, just above the Golden Cycle, is suing the latter for $2,700,000, the value of the ore which the plaintiff alleges was extracted from its ground, contending that the apex of the vein on which the defendant company is working, and from which it took the ore, apexes within the Christmas company's lines. The Golden Cycle company admits a $75,000 liability, but resists a larger claim. An injunction is also being asked to prevent the Golden Cycle company from further working this vein, its principal and richest one.

Portland—The 18th annual report shows the following: Tons shipped last year, 50,258; gross value, $1,140,054; total production since Apr. 1, 1894, 1,318,261 tons; gross value, $32,827,057; dividends last year, $240,000; total to Jan. 1, 1912, $8,917,080; total development to date, 237,062 ft., or about 45 miles; gross profit for year, $370,913; total income, $380,579; cash balance to 1912 account, $97,023. During the year $11,733 were paid toward the drainage tunnel, making a total of about $60,000 to that fund. It is stated that the Colorado City mill is being changed from chlorination to cyanide at a cost of $100,000. During December, the Victor mill treated 12,285 tons; gross value, $31,432; average, $2.80 per ton; recovery, 80.05%. The cost of treatment was slightly over $1.13 per ton by the Portland process.

SAN MIGUEL COUNTY

Tomboy—During January the mill crushed 8900 tons of ore, yielding $83,500 gross and net $33,500. Expenses were $50,000 and $2828 were spent on permanent improvement.

Michigan

COPPER

Calumet & Hecla—The order recently placed with the Allis-Chalmers Co. calls for a mixed-pressure turbogenerator of 7500-kw. capacity. The exhaust steam of the steam stamps will be used, and it is calculated that about 5500 kw. can be secured from this source. This addition to the electric power plant will give the company about 20,000 hp. in electric power. The proposed new regrinding mill is to be electrically driven and will require about 4000 hp. in motors. The company is also planning on the installation of additional electrically driven mine pumps.

Hancock—The vertical shaft is sinking below a depth of 3300 ft., and is in proximity to the point at which it was estimated that the Pewabic Lode would be reached. Developments are being watched with interest. Nothing is being done on any of the formations encountered in the shaft, but as soon as the shaft reaches its permanent bottom the other lodes will be fully developed.

Houghton Copper Co.—The further extension of the crosscut from the 600-ft. level of this company's shaft shows the lode that was reached recently to be heavily mineralized, and the management is encouraged.

Indiana—The company has started cutting a plat at the 600-ft. level. The shaft is bottomed in the formation, showing an encouraging amount of copper.

Mayflower—It is reported that a change of management is imminent and that those who are opposed to the Fay management are soliciting proxies for the meeting on Mar. 20. It is generally conceded that the St. Marys Mineral Land Co. holds the balance of power through its ownership of 25,000 shares.

Isle Royale—The old hoist at No. 5 shaft is to be replaced with one formerly in use at the Tamarack, Jr., mine. The latter hoist is good for a depth of 2500 feet.

Franklin—The new 10-ton skip went into commission recently, and it is reported to be working satisfactorily. Mill returns are said to be showing improvement since the resumption of active mining operations.

Allouez—The new engine and shaft house are expected to be ready for operation in about two months. No. 1 shaft has reached the 17th level and No. 2 is at the 21st level; the grade of the rock is said to be satisfactory.

IRON

Oliver Iron Mining Co.—A rescue station has been established at Iron Mountain on the Menominee Range. Three oxygen helmets and a pulmotor have been provided, and men are being instructed in rescue work. The Chapin mine, the largest iron ore producer in Michigan, is the chief holding of the Oliver company at Iron Mountain and the Aragon mine, at Norway belonging to the same company is 10 miles distant.

Ladenburg, Thalmann & Co.—These interests, known at Florence, Wis., as the Florence Iron Co., and at Iron River, Mich., as the Bates Iron Co., have taken an option on Sec. 36-T. 44-R. 33, in the Amasa district, and have let a contract for diamond drilling to the Cole & McDonald Exploration Co. Ore formation has been found to the southeast on Sec. 6-T. 43-R. 32, and the Hancock, Michigan, and Gibson mines lie to the northwest.

Pickands, Mather & Co.—This company is exploring the Warner property in Sec. 9-T. 44-R. 33 in the Amasa district. The land lies between the Michigan mine of the Oliver company and the Gibson mine of the Rogers-Brown Ore Company.

Champion—This specular hard-ore mine of the Oliver Iron Mining Co., on the western Marquette Range, is practically idle. The Buckeye exploring company, which has been drifting on the 2000-ft. level of the Champion mine, for exploring ground to the west, thus saving the cost of sinking a shaft, has stopped work; only a small lens of ore was cut. The underground operations of the Buckeye company have been directed by Capt. John Thomas, of Ishpeming.

Maas—It is reported that this mine of the Cleveland-Cliffs Iron Co., in Negaunee, will be reopened in the spring. The mine has been closed down since last spring, when the wooden shaft was replaced by a concrete drop shaft, sunk by the Foundation Company.

Minnesota

MESABI RANGE

La Rue—It is reported that this property of the M. A. Hanna company will resume operations on Mar. 1. Two years ago, considerable money was spent in improving the property, installing new machinery, etc., but since then little ore has been shipped. Butler Bros., contractors, are expected to resume stripping operations with one shovel on Mar. 1; when the pit is sufficiently large, a second shovel will probably be installed.

Platt—This mine, according to reports, will begin underground work early this spring. The ore, heretofore, has been hoisted from an open pit, but it is thought that a shaft will be sunk.

Hull-Rust—Trouble, due to encroachment of mining operations upon private property, culminated recently in the cessation of winter mining operations at this and the Burt-Sellers pits. The men have been paid off and it is not known when work will be resumed. These are two of the largest properties on the range.

Mahoning—It is locally reported that this property will be stripped between the present open pit and the viaduct, where there is said to be a body of high-grade ore, which is wanted for mixing with that being taken from the pit.

Scranton—Drifting and raising are in progress and the mine is being put in shape to move the ore rapidly when it is wanted.

Missouri

Cherokee—This mill, at Thoms Station, is nearly completed, and will soon be operated. J. M. Short, of Joplin, is manager.

Hayseed—This mill, near Carthage, has burned to the ground. Thomas Douglas, of Joplin, is manager.

Double D—The ground at this mine, at Carterville, has caved in and may take in the mill.

Minor Heir Sunrise—This company, operating the Sunrise mine, at Spring City, has pumped out the water, repaired the mill and is now producing ore.

Nevada—This zinc smeltery has been remodeled, and is now producing spelter.

Doe Run Lead Co.—This company is floating a 3-year issue of bonds, amounting to $2,200,000, on its 6700 acres, to finance heavy investments made in the acquisition of more property and the enlargement of its plant. It has produced $11,400,000 worth of lead and for years has paid 6% on its stock.

National Lead—The company has taken an option on the Jake Day tract of the Potosi Mines Co., on which a shaft was recently completed. Diamond drills have been moved to the property to test the orebodies. This tract includes 357 acres situated on Big River in the heart of the disseminated lead belt. The property was acquired for about $1000 per acre and is said to be optioned at about double this amount.

Montana

Butte District

Anaconda—The Butte, Anaconda & Pacific Ry. and all its branches are to be electrified. It is expected that the new system will be in operation early in 1913. The electric locomotives are already being constructed. The General Electric Co. has the contract.

East Butte—Mining operations are still confined largely to the orebody on the 800-ft. level, from which about 30,000,000 lb. of copper have been mined by the company under its present management; development work, however, is being carried on extensively on the 1000-ft. level, and within six months the orebody now being mined on the 800-ft. level will be opened on the 1000-ft. level, with what the management has every reason to believe, as good or better results than on the level above. It has been decided to increase the orebin capacity, and to install a mechanical charging system, at the smeltery on the property.

Deer Lodge County

Southern Cross Extension—This and the Early Spring lode claims, adjoining the Southern Cross mine in the Georgetown mining district, have been purchased by John D. Pope, general manager of the North Butte company in Butte. The Southern Cross Extension was deeded from H. C. Bacorn to Mr. Pope, and the Early Spring from B. W. Todd, F. W. Bacorn, and H. C. Bacorn, with the purchase price not given. Mr. Pope and Mr. De Peu, chief clerk of the North Butte company, own several other claims adjoining these two and, with these additions, are possessors of a valuable group of claims adjoining the Southern Cross on the northwest. It is their intention to begin development soon. The advent of the Anaconda company into the district is causing activity there.

Hidden Lake—Regular shipments of ore to the Washoe smeltery are being made from this property in the Georgetown district, and extensive development work is being carried on at a number of the claims, including the sinking of a shaft on the Gold Bug claim. R. R. Robinson, one of the owners, is in charge of operations.

Jefferson County

Sunlight—For the purpose of operating this mine, near Whitehall, the Montana Merger Mines Co. has been incorporated at Virginia City, with a capitalization of $1,500,000. Officers and directors are: Amos C. Hall, president; Jacob Albright, vice-president; L. D. Moritz, secretary and treasurer; Harry E. Hall, F. C. Ball, R. E. McConnell, and S. V. Stewart all of Virginia City; D. A. Morrison, of Whitehall, and R. C. Monahan of Butte.

Madison County

Pittsburg—It is probable that the coming summer will witness the continuation of work on the company's properties, situated about 10 miles from Twin Bridges, near the head of Bear Gulch, and closed two years ago owing to difficulty among the owners. The owners are Bielenberg & Higgins, of Deer Lodge, and Roy, Samuel and George Pritchett, Mr. Bielenberg holding the controlling interest. Considerable good milling ore and some high-grade base ore were blocked out at the time operations were suspended, and the company plans to add new machinery for treating the ore and to drive a 1000-ft. tunnel to develop the property.

Nevada

Comstock Lode

Consolidated Virginia—It is announced that the management will soon start a raise in the rich streak of ore recently cut on the 2550-ft. level in the southwest drift, and will carry it to the 2450-ft. level. This raise will serve the double purpose of making an air connection with the level above, which is open direct with the C. & C. shaft, a downcast, and of prospecting the vein. The ore shows well in the roof of the drift and also in the bottom. This work will be started as soon as the west crosscut has opened the formation to the footwall. An east crosscut has been started on the 2450-ft. level from the main northeast drift to connect with the raise from the 2550 level.

Union Consolidated—The directors have elected C. E. Julihn superintendent of the property, to succeed Whitman Symmes, and the former has taken charge. An east crosscut has been started from the main north drift to explore the vein formation on the hanging-wall side. Mr. Julihn has also been made superintendent of the Sierra Nevada mine.

Ophir—A west crosscut is being driven on the 2100-ft. level from the main south drift, that has been skirting the old stopes of the Hardy vein. The gross assay value of the ore recovered from the mine last week was $11,000. One car of concentrate was shipped to the smeltery.

Crown Point—The last report from the mine shows increasing grade of the ore from the 1400-ft. level, the recovery last week amounting to $4000. The Yellow Jacket mill is operating to capacity on ore from the mine, repairs to the plant having been completed.

Yellow Jacket—The annual report of Superintendent Sturges for 1911 shows that 21,954 tons of ore from the surface dumps were treated at the mill, the assay value of which was more than $57,000. The mill crushed 39,095 tons, of which 17,141 tons were from the Crown Point mine. The Yellow Jacket company will resume active work in the mine as soon as the water is lowered in the deep levels, through drainage from the Ward shaft, now being attempted with good prospects of success.

Mexican—The mill has resumed operations after a shutdown for the monthly cleanup, and for the installation of a larger classifier. Three bars of bullion were shipped to the smeltery as a result of the month's run.

Esmeralda County

Goldfield-Belmont—It is announced that another shipment of high-grade ore has been made recently, amounting to 26 tons and averaging $90 per ton.

Lander County

Some good veins are being opened in the new camp of Carroll, 40 miles south of Austin. Activity is expected to increase with the arrival of spring.

Nye County

Tonopah Extension—The output for January amounted to 4619 lb. of bullion, valued at $50,809, the mill having treated 3760 tons of ore during the month.

Tonopah Belmont—The main shaft is now 1420 ft. deep and has been sunk a depth of 65 ft. in the vein, which at this point is nearly vertical. For 53 ft. the ore was of high milling grade, but is now low grade on the footwall. A winze on the vein 300 ft. east of the shaft is 70 ft. deep, the entire distance in high-grade shipping ore.

Jim Butler—The report for the fiscal year ended Sept. 30 shows: Total receipts, $25,817; disbursements, $23,939; balance, $1877.

White Pine County

Nevada Consolidated—A new steam shovel is reported to have been received

for use in the pit at Copper Flat. Seven shovels are now in service and one will be moved to McGill to excavate for the new settling tank at the Steptoe concentrator. The force at the Veteran mine has been increased to 300 men, and this has increased the total payroll of the Ely district to about 3000 names.

Utah

Beaver County

Atlas—It is reported that a lease and bond have been taken by Park City men on this property, southwest of the Moscow. The development includes a 600-ft. tunnel and a 500-ft. incline.

Horn Silver—The showing on the 400-ft. level continues good; the ore has been followed 40 ft. along the strike and is 15 ft. wide. A 10-ft. face of lead ore of good grade has been opened on the 720-ft. level.

Box Elder County

Box Elder Consolidated—Articles of incorporation for this company, organized in Brigham City, have been filed. The capitalization is 500,000 shares, par value 10c. C. M. Peterson is president. A good surface showing is reported.

Juab County

Chief Consolidated—The annual report has been issued. During 1911 there were produced 6703 tons of ore, net profits from which were $13,929. The net value per ton was $15.59, the ore averaging 0.048 oz. gold, 39.584 oz. silver, and 5.277% lead per ton. The development work amounted to 3300 ft., of which 2682 ft. were drifts, 519 ft., raises, and 99 ft., winzes. A small product of fairly good ore has been gained, and the ore has been improving in quality and quantity, with depth. On the north the ore has been found, and is being followed under the town of Eureka, where ore of good grade is being stoped. Drifting has been done to the east and west under the town in an effort to develop other ore zones, and the western drift is within a few hundred feet of neighboring mines, working on independent ore zones.

Tintic Mining & Development—Preparations are being made to work this property, northeast of the Gold Chain and Mammoth. Prospecting will be done through the Sioux-Ajax tunnel. The company is a close corporation. J. W. D. Moodie is manager.

Crown Point—The drift on the 500-ft. level eastward from the shaft has attained a length of 170 feet.

Eureka Hill—In December four cars were marketed, and in January two, some of the ore netting about $1000 per car. The ore comes from ground adjoining the Centennial-Eureka, which is being worked through that property under a lease.

Grutli—This property, consisting of a group of patented claims in the eastern part of the district, is making preparations to sink a winze from the 200-ft. level. The property has not been in operation for some time.

Sioux—Drifting is being done to prospect the ground underneath the cave encountered recently.

Lehi Tintic—A tunnel is being driven to prospect ground under the 400-ft. incline shaft. The tunnel is 1075 ft. long, being about 200 ft. from its objective point. The face shows iron-stained quartz, similar to that found with the ore in the incline.

Santaquin Chief—A tunnel, the face of which is 120 ft. from the surface, is being driven; it is in 150 ft., and there is ore reported for two-thirds of that distance. A cave with ore in the bottom has been broken into, and a winze is being sunk to prospect it at greater depth. Twenty tons of sorted shipping ore are piled in the tunnel, and there are 40 tons on the dump. The ore is lead-silver, averaging $35 per ton. There is also some zinc.

Grand Central—The shaft is being sunk 3½ ft. per day. Shipments are being maintained.

Salt Lake County

Utah Metal—Work on the Tooele-Bingham tunnel is progressing at the rate of about 10 ft. per day. The face is in hard quartzite, but the work is being done at an unusually low cost. The Tooele side is in about 6600 ft. and the Bingham side about 400. Two shifts are being used. The work on the Bingham side is in Bingham Central Standard ground.

Alta Consolidated—Settlement for 23 tons of ore recently shipped brought $993. Shipments were suspended some time ago on account of heavy snows, but the roads have been opened again and teams are hauling 80 tons of ore per day. Work on ore is being done in five or six places, and 18 men are employed.

Utah Copper Co.—The eighth section of the Arthur mill is expected to go into commission on Mar. 1, and it is planned to place an additional section in operation each succeeding month until the 25 sections are in full operation, 12 at the Magma and 13 at the Arthur mill; these will handle about 20,000 tons per day.

Summit County

New York Bonanza—This property is reported to have marketed 133 tons the past week, and 114 tons the week preceding. The ore brings about $10 per ton and comes principally from the fourth level.

American Flag—Development at this property is being done chiefly on the 1100-ft. level. The main shaft is 1170 ft. deep. No shipments have been made since last April, but previous to that gold and silver ore was shipped to the American Smelting & Refining Co. About two-thirds of the content of the ore is in silver.

Canada

British Columbia

Large areas of anthracite coal are reported to have been found in the region at the headwaters of the Skeena River, about 150 miles north of Hazelton. It is said that a good-sized party of engineers has spent considerable time in the district recently, and that good seams of coal are said by them to underlie a large expanse of territory.

Yankee Girl—It is reported that a 100-ton mill will be erected at this mine at Ymir, next autumn. Robert Mabry, of Spokane, Wash., is one of the owners.

British Columbia Copper—The report for the year ended Nov. 30, 1911, shows total revenues of $1,968,159, an increase of $501,419 over the previous year. Total assets were $3,826,032, a decrease of $135,870. Total deductions of $1,834,-229 left a balance of $133,930 for dividends, resulting in a deficit for the year of $14,001. President Erb states that considering the low price for copper that prevailed and the difficulties incident to the coal strike, the results for the year were favorable and that the prospects for the coming year are satisfactory.

Ontario-Cobalt

Cobalt shipments for the week ended Feb. 10, were: Nipissing, 144,920 lb.; Temiskaming, 133,212; Drummond, 120,-650; McKinley - Darragh, 120,452; O'Brien, 71,592; La Rose, 65,339; Kerr Lake, 41,056; total, 697,221 lb. Bullion shipments were: Nipissing, 143,213 oz.; O'Brien, 19,570; Crown Reserve, 15,000; miscellaneous, 7293; total, 188,077 ounces.

Nipissing—January production amounted to 406,826 oz. of silver, of a gross value of $224,903. This compares with 407,114 oz. for December, 403,408 for November and 431,986 for October. Shipments were small and amounted to ore valued at $113,647. This was due to the closing of the high-grade plant for the annual cleanup.

Trethewey—During the last calendar year the mine produced 716,464 oz. of silver, of a gross value of $373,486. Reserves were increased by an almost equal amount.

Beaver—Shaft No. 1 is down 550 ft. and sinking is being continued. A station is being cut and a level established at 530 feet.

Provincial—A vein 1½ in. wide of rich ore, with silver shot through the wall rock for 2 ft. on each side, has been encountered in the conglomerate, 60 ft. from the shaft at the 300-ft. level.

ONTARIO-PORCUPINE

Crown Chartered—A new road has been cut from this property to the town of South Porcupine; it will also serve the other miners in that section.

Leighton-Warner—A 10% dividend has been paid on the outstanding capital. The money comes from the sale of properties.

Iroquois—Free gold has been encountered in the shaft at a depth of 40 feet. Machinery has been installed recently.

Little Pet—The 5-stamp mill for this property has been shipped. Foundations for the mill have been started. The drift on the 100-ft. level is in about 12 ft. on a vein of good ore, 3 ft. wide.

Dome Lake—A compressor is to be installed, and diamond drilling is still giving good results.

West Dome—The mine has been partially closed down.

Kelso—This nickel property is to be opened under the direction of the original owners.

Dome Extension—Drilling near the Dome boundary at a vertical depth of 500 ft. showed 20 ft. of gold-bearing vein matter.

Martin—Work has been suspended on the property.

Dobie—Crosscuts have been started at the 60- and 90-ft. levels, respectively, of the two shafts.

Winyah Gold Mining Co.—This recently organized company, has taken over four claims in Mountjoy Township, owned by R. A. Cartwright. Diamond drilling will be started soon. A shaft has been put down to a depth of 56 ft. and some development work done, with good results on the 50-ft. level. A. W. Grierson has been appointed manager.

North Dome—A vein 2 ft. wide carrying free gold has been encountered at 60 ft. in No. 2 shaft.

McEnany—An orebody 5 ft. wide, carrying good ore has been cut at the 173-ft. level. Coe Carson and Samuel Cohen, president and general manager of the Crown Reserve, recently visited the property.

O'Brien—A rich silver deposit has been struck between two veins at the 150-ft. level of this Gowganda property. There is leaf silver on the wall rock on each side of a calcite vein which carries silver in nuggets.

Porcupine Reserve—A larger plant is to be installed on this property.

ONTARIO-SUDBURY

Mond Nickel Co.—The company has secured about 2400 acres of land at Coniston, as a site for the new smeltery on which it is understood active operations will be begun this spring.

Mexico

CHIHUAHUA

Santa Reyes—Some excitement was caused recently by a strike of bonanza ore at this mine in the Andres del Rio district. Mr. Monge is operating the property, having purchased it about a year ago from Doctor Durand. Development work has been carried on since then.

Alvarado—The order for the new aërial tramway to connect the Presena mine and the mill opposite the Palmilla mine has been placed and construction will begin soon. The ropeway will be 12,500 ft. long between terminals and will be supported by 32 towers. Gravity supplemented by a motor at the discharge terminal will be the power employed. The discharge terminal will be constructed of steel, but the towers will be of wood. The tramway is expected to handle 350 tons per 10-hr. shift, which is more than the present capacity of the mill. New tube mills, however, will increase the capacity of the latter.

San Juanico—The Alvarado company is considering the resumption of active work at this mine. Work in a small way is going on at present with leasers and tributers.

La Cumbre v La Bufa—Two cars of ore were shipped to the Torreon smeltery recently.

El Tajo—The new concentrator is treating about 2000 tons per month. The new pump is giving satisfactory service. H. H. Utley is in charge.

Tepehuan Mexican Syndicate—The new machinery for the mine at Ceballitas has arrived at Parral and will be forwarded soon.

Alfarena—The ore bins have been put in good condition and the new electric hoist is expected to be working in about six weeks. The shaft at this mine is an inclined one and parallels the vein at a distance of about 50 ft. in the footwall. The ground requires little timbering. T. G. Hawkins is in charge.

JALISCO

El Favor—Good orebodies are reported to have been opened recently. Cyanide tests are said to have shown that a good extraction is possible. Reduction equipment for an addition to the present plant has arrived at Magdalena and a contract has been let for transporting it to the mine. The present mill is not large enough to handle the tonnage from this and the Mololoa mines.

OAXACA

San Juan—Judge L. R. Wilfrey, of Mexico City, recently purchased the interest of C. A. Hamilton, in this mine, at Taviche, for 1,000,000 pesos. The mine was developed by Mr. Hamilton, but became involved in a lawsuit, after which it reverted to Juan Baights, who worked it for three years. It is stated that the smeltery returns for 1911 were 900,000 pesos. A mill will be erected.

SONORA

It is reported that a concentrator will be erected at Tesia, a station on the Mayo River, about five miles from Navajoa on the Alamos branch of the Southern Pacific R.R. It will be of 200 tons capacity.

La Dura—A strike of employees is reported to have occurred recently, in which an increase in wages of 33⅓% was demanded.

Cicero Smith—J. H. Reagen, of Patagonia, is moving the mining machinery from this mine to a point on the Yaqui River where it will be erected and placed in operation.

Muchacho Grande—This company, operating in the Alamos district, is reported to have arranged for building a concentrator at Victoria station on the Alamos branch railroad.

South Sonora Silver Mining Co.—This company, composed of Kansas City and New Orleans men, is operating on a group of claims near the Plata Fino group. It is reported that machinery will be installed soon.

South America

COLOMBIA

Guadaloupe & Porce Mining Co.—This company is composed principally of Denver, Colo., men and has recently acquired extensive placer properties on the Guadaloupe and Porce Rivers. F. L. Norman, engineer for the company, has purchased and shipped a complete hydraulicking plant. This is expected to arrive soon and ditches and flumes are now under construction. The plant includes 2000 ft. of 16-in., and 300 ft. of 12-in. pipe, all of which will be shipped in 3-ft. sections, punched for double riveting. The elevator is of the Evans type and is expected to raise to a height of 50 ft., all the material under 6-in. size that can be washed to it by a 2½-in. giant. The depth of the gravel is from 20 to 35 ft. Numerous tests are said to have indicated a content of about 80c. per yd. Active washing operations will be in charge of James Boger and the compony's headquarters are in Denver, Colorado.

Asia

CHOSEN

Oriental—During December, 26,121 tons of ore were crushed, yielding gross $136,755. The Kuk San Dong mill and dump plant were closed during the entire month due to lack of labor causing a shortage of wood. The Candlestick mill had five stamps hung up all month owing to lack of labor in the mill. Labor conditions are improving.

The Market Report

Current Prices of the Metals, Minerals, Coal and Mining Stocks

Coal Trade Review

New York, Feb. 14—Demand is increasing in the coal trade; both in the West and the East. Part of this demand is immediate, arising from weather conditions, and part is prospective, being due to the desire of large consumers to put in stocks to provide against possible shortage in April. The present difficulty in the trade arises from shortage of cars and from slow transportation on the railroads, due to the weather. Operations at mines have been subject to some delay from the severe cold, but all demands could be met if the railroads could only move the coal promptly. They are not doing this and the trade generally is in confusion. Prices are advancing, but there is much trouble about deliveries everywhere.

Anthracite shipments in January are reported at 5,763,696 long tons; which is 351,731 tons less than in December, and 140,421 tons less than in January last year.

Austrian Coal—Coal production of Austria year ended Dec. 31, metric tons:

	1910	1911	Changes
Coal.....	13,773,985	14,861,314	I. 1,087,329
Brown coal.....	25,132,855	25,255,429	I. 122,574
Total mined..	38,906,840	40,116,743	I. 1,209,903
Coke made.....	1,999,106	2,076,978	I. 77,872
Briquets made.	334,218	347,597	I. 13,379

Of the briquets reported in 1911 there were 208,759 tons made of brown coal or lignite.

Iron Trade Review

*New York, Feb*Y 14—The iron trade has been moving rather steadily, reports generally showing fuller operation of mills. Specifications on contracts come in quite freely, and new business is not lacking, though there is no resumption of the December rush. Structural steel continues in demand and business in plates and sheets is good. Reports from the wire trade are favorable. As spring approaches there is an increasing demand for bars and smaller material. The reported blowing in of several steel works furnaces indicates an increasing demand for finished steel.

Pig iron has shown some activity, owing to a better demand from foundries, inquiries for large lots of pipe iron, and some call for basic pig. The general report is that stocks have been pretty well cleaned out, and that any further increase in demand will require the blowing in of more merchant furnaces. There has been no material change in prices.

The official estimate for next season's shipment of ore from the Great Northern ore properties, by the Oliver Iron Mining Co., is reported to show an increase of 31.5 per cent. over 1911. Last year shipments were 6,883,000 tons. The estimate recently submitted for this season's shipment from the Hill properties, gives a total of 9.050,000 tons.

Pig-iron Production—The reports of the blast furnaces, as collected and published by the *Iron Age,* show that on Feb. 1 there were 227 coke and anthracite stacks in blast having a total capacity of 71,100 tons of iron daily; an increase of 3500 tons over Jan. 1. Making allowance for the charcoal furnaces, the total make of pig iron in the United States in January is estimated at 2,077,500 long tons.

Steel Corporation Orders—The statement of unfilled orders on the books of the Steel Corporation on Jan. 31 shows a total of 5,379,721 tons of all kinds of material. This is 294,981 tons more than on Dec. 31, and is the largest tonnage reported since March 31, 1910. It is 2,-268,802 tons more than on Jan. 31 of last year.

The Steel Corporation showing is favorable, but it must be noted that shipments were somewhat decreased in January as compared with December, on account of the weather, and despite the fact that during the month the corporation made an increase in the capacity nominally in operation. The December increase in unfilled tonnage was 942,806 tons; the January increase was 647,846 tons less, and considering the presumptive decrease in shipments it may be taken that actual bookings decreased 700,000 tons or more from December to January.

Baltimore

Feb. 12—Exports for the week included 129,920 lb. wire and 83,105 lb. nails to Dublin. Imports included 15,915 tons iron ore from Cuba.

Birmingham

Feb. 12—Southern pig-iron manufacturers report a little lagging in the selling but the market is still in a fairly satisfactory condition. The price of pig iron in this section has taken on some strength, a few sales having been made at $10.50 per ton, No. 2 foundry and the inclination is to make that price the basis for all iron that will be sold for delivery during the second quarter of the year. Inquiries are coming in steadily for iron for delivery during the last half of the year and it is believed there will be good business through the year. The make is still off. Alabama during January produced only 146,212 tons of iron against 161,976 tons in December, the month previous. The accumulated stock of iron in the Southern territory is still of considerable size but there is a steady reduction and by the end of four months it will be almost wiped out.

There is still discussion in this section as to reductions in freight rates to Ohio gateway points; the independent manufacturers in the South will shortly present a petition to the Interstate Commerce Commission looking to a lower freight rate, a reduction of at least $1 per ton, to Ohio points.

There is a satisfactory condition, everything considered, in the steel trade in the Southern territory. In fabricated steel there is continued activity. The rail trade is steady, though the Emiley plant is not making its full capacity. Steel-wire goods are moving well.

Chicago

Feb. 12—The iron market is quiet; there has been no important change from the conditions noted last week. Pig iron is in light demand with sales only in small quantities and not extending beyond first-half deliveries as a rule. It seems more than ever a waiting market. Transactions in charcoal pig iron have quieted and the market rests on the small though numerous needs of the coke-iron smelters.

Southern No. 2 coke iron sells for $10@10.50 Birmingham, or $14.35@14.85 local delivery, the lower price obtaining easily on any good-sized order. Northern No. 2 brings $14@14.50 and Lake Superior charcoal iron $16.50@17. There are a few inquiries for lots of more than 1000 tons, but they seem to be put out more to feel the market than to place contracts.

Iron and steel products make a better showing, the local mills being well supplied with orders and sales of the leading lines being satisfactory. Structural material is in increasing demand for bridge and building work in the West and Southwest with scattering sales in local and northwestern territory; beams and channels under 15 in. continue at 1.30@1.38c. Aside from the occasional sales of heavy rails in large quantities of which the local mills get a share, there is a good, steady demand for track fastenings and light rails. Bars are steady, with little if any price cutting reported, bar iron

being quoted at 1.15@1.20c., and mild steel bars at 1.25@1.33c. Plates are holding to 1.30c. minimum, with the demand not so active, but still fair. Minor lines show good sales and prospects of new business.

Cleveland

Feb. 12—While no prices for ore are made yet, several contracts for delivery during the season have been made, subject to prices which may prevail later. The large inquiry from the East, which was noted last week, has not yet developed into actual business.

Pig Iron—The market is inclined to be slow, though a fair business has been done in small orders. There is some inquiry for basic. Current quotations, Cleveland delivery, are $15.15 for bessemer, $13.25 for No. 2 foundry, $12.50 for forge and $16.50 for Lake Superior charcoal.

Finished Material—Some contracts have been let for structural steel and plates. Wire is active. Prices on bars are rather irregular; also on sheets.

Philadelphia

Feb. 14—The feature of the pig-iron market today is the large number of inquiries, largely from small consumers in widely scattered localities. Furnacemen hope for a permanent advance of 25c. on most of the new business where small orders are placed. The larger consumers are negotiating, but show an unwillingness to close promptly. Low-grade iron for pipe purposes has slightly advanced and on account of the well sold up condition of the furnaces a further permanent advance is regarded as probable. All kinds of iron are decidedly stronger as judged by the statements and attitude of the leading furnace interests of this territory. Makers have declined a few offers for third-quarter delivery, believing that it is not advisable to commit themselves to such remote delivery in the present situation. Forge iron is moving steadily, but as usual in rather small lots. Malleable has regained its former activity and a few contracts have been placed for supplies running to midsummer. Basic has not changed and new business is of small volume. The general tone of the market is decidedly stronger from the makers' point of view, but this conclusion is not accepted by buying interests.

Steel Billets—The heavy buying of material into which steel billets enters has at least strengthened the market, but actual sales at stronger figures cannot be proven. The minimum quotation of billets is not changed.

Bars—Bars have not advanced in a large way, in fact large buyers find no difficulty in securing all the material they want on practically their own terms.

Sheets—Sheets maintain their advantage and new business for the week shows a marked increase over last. Much business for the latter part of the second quarter has been placed.

Pipes and Tubes—All the reports concerning tubes are favorable. Merchant pipe is doing better in orders for spring delivery. The cast pipe interests are all loaded up with business.

Plates—Only a moderate business has been done in plates, although there are enough orders to be placed to satisfy the mill interests. The larger buyers are hesitating for some reason not apparent and the manufacturers are holding their minimum quotations very firmly.

Structural Material—Structural material is quiet, comparatively speaking, the only business closed this week being the acceptance of orders which have been occupying attention for two or three weeks. Much of this material is for construction work in New York and in some New England cities. A few moderately large orders have been placed on account of Philadelphia enterprises and a number are likely to be placed.

Scrap—Very little business has been definitely placed, but consumers are asking for quotations which will lead to business probably by the middle of March. The present quotations do not invite them, but the scrap dealers claim the prospective supply will enable them to maintain their quotations.

Pittsburg

Feb. 13—The finished-steel market has not lost ground in the past few days, but it has not gained. Last week the eagerness of certain mills, particularly in the East, resulted in prices on bars, plates and shapes becoming quotable at 1.10c., Pittsburg, on desirable orders, a decline of $1 a ton from the advanced quotations of December; but it must be observed that the advanced prices were at no time the subject of any general trading. The mills put up their quotations to the 1.15c. level, and in a few cases to a level of 1.20c., simply because they had booked an unusually large amount of tonnage in a few weeks at especially low prices, and were in position to try the effect of advanced prices. The effect might have been altogether favorable if weather conditions had been normal; as it was, the extremely cold weather tended to retard the placing of business and some of the mills became ready to book desirable orders at 1.10c., or $1 below the former asking price, but somewhat above the prices actually obtaining on the material which is being shipped this quarter.

Since this decline the market has not suffered further. There is not a great deal of competition, for the reason that the Steel Corporation and some of the independents are well sold up, on one product or another, so that the competition has been relatively limited.

Pig Iron—The Jones & Laughlin Steel Co. is this week blowing in one of its Aliquippa furnaces, and will blow in a second about Mar. 1. The Carnegie Steel Co. has given orders to blow in its Niles stack, in about a week, and this, with the second Isabella furnace being started, will make 52 of the 59 Carnegie furnaces in operation. The Steel Corporation will not buy any merchant bessemer iron, as was reported last week it might do. The Shenango Furnace Co. blew out one of its stacks, Feb. 4, and will rejacket and reline it. Perry furnace, at Erie, has also gone out, and will be relined. The merchant furnaces now in operation are well sold up, according to their reports, and the local pig-iron market perhaps owes its steadiness to this fact, as current demand furnishes no support, inquiry and actual buying being extremely light. We quote: Bessemer, $14@14.25; basic, $12.25@12.50; No. 2 foundry, $13@13.25; forge, $12.50@12.75; malleable, $13@13.25, all f.o.b. Valley furnaces, 90c. higher delivered Pittsburg.

Ferromanganese—The market is very quiet, with the price well maintained at $41, Baltimore, for prompt and forward, freight to Pittsburg being $1.95. The steel interests are much exercised over the feature of the Underwood bill which places the duty on ferromanganese at 15 per cent. *ad valorem,* the same percentage rate as is placed on pig iron. This, at the present level, would make the duty about $5.40 per ton, against $2.50 in the present law and $4 a ton in the old law.

Steel—The Carnegie Steel Co. is oversold on billets and sheet bars and is entirely out of the markets on these products. Some of the mills are ready to book additional orders at less than the asking prices of 30 days ago, though not at as low prices as obtained in November. We continue to quote bessemer and openhearth billets at $19.50@20 and sheet bars at $20.50@21, Pittsburg; bessemer billets at $19 and sheet bars at $20, Youngstown.

Sheets—The market continues irregular, with one mill or another usually ready to shade the openly recognized prices by $1 a ton, and occasionally by a trifle more in the case of black sheets. The leading interest is well sold up, and so are some of the independents. We quote: Black sheets, 28 gage, 1.85@1.90c.; galvanized, 2.85@2.90c.; blue annealed, 1.35@1.40c.; painted corrugated, $1.33@1.35 per square; corrugated, $2.47@2.50 per square.

St. Louis

Feb. 10—There has been nothing to disturb the even tenor of the pig-iron market during the past week. Buying has

been light and inquiries few. All sales are of small lots. There will probably be little done for another 30 days, when it is expected that buying for the third quarter will open up. The price on Southern iron remains $10@10.25, Birmingham, or $13.75@14, St. Louis. Not much interest is being shown in Northern iron; $14.25@14.75 is the present quotation.

The demand for coke from the foundries is fair and prices are quite stiff at $2.25@2.40, at ovens, or $5.05@5.20, St. Louis, for 72-hour foundry. The high price of coke is more reflection of the general coal and railroad situation than from any heavy demand from founders.

Iron Ore Trade

It is stated that a lot of iron ore from Wabana, Newfoundland, has been contracted for by an Eastern furnace at 7c. per unit, f.o.b. cars at Philadelphia. Some large lots of New York and New Jersey ores have been placed at 7¼@7¾c. per unit, delivered. These prices are slightly under last year.

The Eastern Steel Co. is negotiating for 150,000 tons of Lake Superior ores for Warwick furnaces at Pottstown, Penn. The question to be settled is the price.

Imports and exports of iron ore in the United States for the full year, long tons:

	1910	1911	Changes
Imports	2,591,031	1,811,732	D. 779,299
Exports	748,875	768,386	I. 19,51

Exports are chiefly to Canada. The imports in 1911 included 1,147,879 tons from Cuba; 219,238 from Sweden; 194,965 from Spain; 174,853 from Newfoundland; 50,480 from Canada; 24,317 tons from other countries.

Imports of manganese ore were 242,348 tons in 1910, and 176,852 in 1911; decrease, 65,496 tons.

British Iron-Ore Imports—Imports of iron ore into Great Britain for the year ended Dec. 31, were 7,020,799 long tons in 1910, and 6,328,623 in 1911; decrease, 692,176 tons. Imports of manganese ores were 482,209 tons in 1910, and 358,915 in 1911; decrease, 123,294 tons.

French Iron Ore—The production of iron ore from the Briey Basin in 1911 was 10,427,000 metric tons; which compares with 8,470,000 in 1910, 6,310,000 in 1909 and 4,368,000 in 1908. The increase has been at the rate of about 2,000,000 tons a year.

Foreign Iron Trade

German Iron Production—The German Iron & Steel Union reports the production of pig iron in Germany in December at 1,377,637 metric tons; being 63,741 tons more than in November, and 70,553 tons more than in December, 1911. The total make of pig iron for the year was 14,793,325 tons in 1910, and 15,334,223 tons in 1911; an increase of 540,898 tons, or 3.7 per cent.

Metal Markets

New York, Feb. 14—The metal markets continue rather interesting, but with no great changes apparent or completed.

MONTHLY INDEX NUMBERS

Month	1911	1912	Month	1911	1912
January	110	111	July	112	.....
February	115	.....	August	117	.....
March	112	.....	September	111	.....
April	114	.....	October	112	.....
May	118	.....	November	111	.....
June	115	.....	December	110	.....

Year 1909, 115; 1910, 115; 1911, 112.
Numbers for each month and year calculated on approximate sales of pig iron, copper, tin, lead, zinc and aluminum.

Gold, Silver and Platinum

UNITED STATES GOLD AND SILVER MOVEMENT

Metal	Exports	Imports	Excess
Gold:			
Dec. 1911	$ 994,677	$ 4,707,330	Exp. $3,712,565
" 1910	1,330,400	4,976,632	Imp. 3,646,232
Year 1911	37,183,074	57,445,184	Imp. 20,262,110
" 1910	58,774,822	59,222,518	Imp. 447,696
Silver:			
Dec. 1911	5,997,360	3,306,727	Exp. 2,690,630
" 1910	6,061,060	4,398,450	Exp. 1,662,61g
Year 1911	65,664,646	43,746,571	Exp. 21,918,073
" 1910	57,360,973	45,878,168	Exp. 11,482,805

Exports from the port of New York, week ended Feb. 10: Gold, $8,344,387, chiefly to Paris and Argentina; silver, $891,970, principally to London. Imports: Gold, $632,809, largely from Mexico and South America; silver, $216,101, from Mexico, Central and South America.

Gold—The price of gold on the open market in London was unchanged at 77s. 9d. per oz. for bars and 76s. 4d. per oz. for American coin. Some gold was taken for India, but otherwise there was no foreign demand. In New York $3,750,000 for Argentina.

Messrs. Samuel Montague & Co., write from London, Feb. 1: "In last week's letter the impression was conveyed that the net imports of gold into India for 1911 would constitute a record. The total for the year was £20,909,442. This heavy total represents considerably over a fifth of the world's output of gold. The large recent withdrawals from London suggest that the imports for the present season will be phenomenal."

Iridium—The price remains about the same, $64 per oz. being asked for pure metal.

Platinum—The market has been quiet and prices rather weaker. Dealers still ask $46, but sales have been made at 50c. less. We quote $45.50 per oz. for refined platinum and $48 per oz. for hard metal.

SILVER AND STERLING EXCHANGE

Feb.	8	9	10	12	13	14
New York	59⅞	60⅛	60⅜	....	60⅝	60
London	27 7/16	27 11/16	27¾	27 13/16	27⅞	27 5/16
Sterling Ex.	4.8705	4.8710	4.8730	....	4.8730	4.8710

New York quotations, cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

Silver—The market has reached this week the highest point yet attained in the present advance. While fluctuations are in order, those in a position to judge think the metal should maintain a high level, owing to the Eastern conditions.

Exports of silver from London to the East, Jan. 1 to Feb. 1, reported by Messrs. Pixley Abell:

	1911	1912	Changes
India	£1,091,300	£835,300	D. £256,000
China	176,000	250,000	I. 74,000
Total	£1,267,300	£1,085,300	D. £182,000

India Council bills in London averaged 16.15d. per rupee for the week.

Movement of gold and silver through the port of San Francisco, year ended Dec. 31:

	Exports	Imports	Excess
Gold	$2,671,597	$7,595,052	Imp. $4,923,455
Gold, 1910	1,989,208	4,373,713	Imp. 2,384,505
Silver	8,865,842	1,502,598	Exp. 7,363,244
Silver, 1910	7,482 529	1,817,919	Exp. 5,664,610

The exports of silver in 1911 included $219,086 in coin and $8,646,756 in bullion. The imports were $737,545 in coin and $765,983 in bullion.

Gold and silver movement in France 11 months ended Nov. 30:

	Imports	Exports	Excess
Gold	Fr.243,206,000	Fr.141,288,000	Imp. Fr.101,918,000
1910	210,988,000	168,684,000	Imp. 42,304,000
Silver	173,037,000	123,939,000	Imp. 49,098,000
1910	152,951,000	190,028,000	Exp. 37,077,000

Imports of copper and nickel coins in 1911, 47,000 fr.; exports, 545,000 francs.

Copper, Tin, Lead and Zinc

NEW YORK

Feb.	Copper: Lake, Cts. per lb.	Copper: Electrolytic, Cts. per lb.	Tin: Cts. per lb.	Lead: New York, Cts. per lb.	Lead: St. Louis, Cts. per lb.	Zinc: New York, Cts. per lb.	Zinc: St. Louis, Cts. per lb.
8	14⅛ @14¼	13.80 @13.90	43	4.00	3.92½	6.40 @6.55	6.25 @6.40
9	14⅛ @14⅜	13.90 @14.00	43¼	4.00	3.92½	6.40 @6.55	6.25 @6.40
10	14¼ @14⅜	14.00 @14.10	43¼	4.00	3.92½	6.40 @6.55	6.25 @6.40
12	.. ..	.....	....	....	.....	.....	.....
13	14.25 @14.45	14.05 @14.10	43⅜	4.00	3.92½	6.40 @6.60	6.25 @6.45
14	14.25 @14.45	14.05 @14.10	43¼	4.00	3.92½	6.40 @6.60	6.25 @6.40

The quotations for copper, lead, spelter and tin are for wholesale contracts with consumers, without distinction as to deliveries; and are representative, as nearly as possible, of the bulk of the transactions, reduced to basis of New York, cash, except where St. Louis is specified as the basing point. The quotations for electrolytic copper are for cakes, ingots and wirebars. The prices of casting copper and of electrolytic cathodes are usually 0.125c. below that of electrolytic. The quotations for lead represent wholesale transactions in the open market; for good ordinary brands, both desilverized and non-desilverized; specially refined corroding lead commands a premium. The quotations on spelter are for ordinary Western brands; special brands command a premium.

Copper—The publication of the statistics, which were unexpectedly favorable, on Feb. 8 aroused a mild interest and that led some sellers to advance their prices to 14⅛c., delivered, but on

LONDON

Feb.	Copper			Tin		Lead, Spanish	Zinc, Ordinaries
	Spot	3 Mos	Best Sel'td	Spot	3 Mos		
8	62⅜	63⅛	66⅛	195¼	192½	15½	27
9	62⅛	63⅜	67	195½	192	15½	27
10	.....	.....	.....	.....	.....	.....	.....
12	62¾	63¼	67	196	192	15½	26¾
13	62⅞	63¼	66¾	197	192¾	15½	26¾
14	62⅜	63⅛	66¾	197⅛	192⅞	15¾	26¾

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb. Copper quotations are for standard copper, spot and three months, and for best selected, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given: £10 = 2.17½c; £12 = 2.61c.; £23 = 5c.; £60 = 13.04c. ± £1 = ± 0.21¾c.

that day and the next some large transactions were made at 14c., delivered, usual terms. Later on the price of 14¼c., delivered, became established, with 14⅜c. asked but not paid. The market then became very dull. Some fair size transactions in Lake copper are reported, up to 14.45c. having been realized, while a special brand is said to have fetched 14.50c. Domestic consumers have been reluctant to follow the advance and the activity in the demand from abroad subsided with the decline in the London market. At the close the quotation is more or less nominal at 14.25@14.45c. for Lake and 14.05@14.10c. for electrolytic in cakes, wirebars and ingots. Casting copper is quoted nominally at 13¾@13⅞c. as the average for the week.

The standard market, after rallying sharply on Feb. 8 and 9, has been reacting ever since, and closes at £62 7s. 6d. for spot, and £63 1s. 3d. for three months.

Copper sheets are 19@20c. base, for large lots. Full extras are charged and higher prices for smaller quantities. Copper wire has been advanced to 15¼c. base, carload lots at mill.

Copper exports from New York for the week were 9555 long tons. Our special correspondent gives the exports from Baltimore at 624 tons.

Tin—The market abroad retains its strength, which finds its main expression in the advance of quotations for spot material. It is reported that the available supplies in the Far East are very much concentrated, and for this reason a scarcity of near-by material in England may develop.

Business here is confined to retail transactions. Spot tin is still at a premium, notwithstanding the very large arrivals in this port. The market closes steady at £197 10s. for spot, and £192 17s. 6d. for three months, and at about 43½c. for February tin in New York.

Production of the mines in Cornwall and Devonshire, England, in 1911, is estimated at 7602 long tons of black tin; 251 tons less than in the previous year.

Lead—The market is dominated by the leading sellers, who are supplying the demand freely on basis of 4c. New York, and 3.92½c., St. Louis.

The London market is slightly weaker, the close being cabled at £15 15s. for Spanish lead, and £15 17s. 6d. for English.

A recent dispatch from London reports the formation of an international combination of white-lead manufacturers, to include all the prominent American and British concerns. This report, so far as American manufacturers are concerned, is denied by the National Lead Co., the principal maker here.

Spelter—The demand for this metal still taxes the current output to the utmost, and as a result premiums are again prevailing for near-by deliveries. The future months have advanced in sympathy, but business at the higher price is not as active as it has recently been, although a fair tonnage in March and April contracts has been reported. The close is firm at 6.40@6.60c., New York, and 6.25@6.45c., St. Louis.

The London market declined about 5s., closing at £26 15s. for good ordinaries, and £27 for specials.

Zinc dust is quoted at 7⅛c. per lb., New York.

Base price of zinc sheets is $8 per 100 lb., f.o.b. La Salle-Peru, Ill., less 8 per cent. discount.

Other Metals

Aluminum—Business has been fair and the market is a little stronger. Quotations are 19¼@19¾c. per lb. for No. 1 ingots, New York delivery.

Antimony—Business has been quiet and prices rather weaker. Cookson's is quoted at 7⅛@7¼c. per lb., and Hallett's at 7⅜@7½c.; while 6¾@6⅞c. per lb. is asked for Chinese, Hungarian and other outside brands.

Quicksilver—The market is strong and prices have advanced. The New York quotation is now $46 per flask of 75 lb., with the usual advances for small quantities. San Francisco, $45 for domestic orders and $42.50 for export. The London price has been advanced to £8 7s. 6d. per flask, while £8 5s. is quoted from second hands.

Magnesium—The price of pure metal is $1.50 per lb. for 100-lb. lots, f.o.b. New York.

Nickel—Large lots, contract business, 40@45c. per lb. Retail spot from 50c. for 500-lb. lots up to 55c. for 200-lb. lots. The price of electrolytic is 5c. higher.

Spanish Metal Exports

Exports of metals and minerals from Spain, 11 months ended Nov. 30, reported by *Revista Minera*, in metric tons:

Metals	1910	1911	Changes
Pig and manuf. iron	35,798	35,091	D. 707
Copper	15,176	15,041	D. 135
Copper precipitate	12,958	12,667	D. 291
Lead	174,741	156,589	D. 18,152
Zinc	1,757	2,556	I. 799
Quicksilver	1,311	1,484	I. 173
Minerals			
Iron ore	7,481,698	6,616,921	D. 865,677
Manganese ore	5,328	28,596	I. 23,268
Copper ore	863,427	270,086	D. 593,341
Lead ore	3,100	2,741	D. 359
Zinc ore	116,978	119,066	D. 2,088
Pyrites	1,362,365	2,529,289	I. 1,166,924
Salt	472,232	482,986	I. 10,754

In 1910 pyritic ores were classed as copper ore when they carried 1 per cent. or over in copper.

Zinc and Lead Ore Markets

Platteville, Wis., Feb. 10—The base price paid this week for 60 per cent. zinc ore was $45@46; market weaker at close. No sales of lead ore were reported; offerings for 80 per cent. lead ore were $48@$50 per ton.

SHIPMENTS, WEEK ENDED FEB. 10

Camps	Zinc ore, lb.	Lead ore, lb.	Sulphur ore, lb.
Mineral Point	1,075,880	.....	.....
Shullsburg	897,950	.....	.....
Galena	818,800	.....	.....
Platteville	485,100	.....	.....
Benton	412,600	.....	121,100
Harker	390,700	.....	.....
Hazel Green	240,000	.....	.....
Cuba City	76,500	51,000	166,500
Total	4,397,530	51,000	287,600
Year to date	20,156,590	586,080	1,504,600

Shipped during the week to separating plants, 1,503,660 lb. zinc ore.

Joplin, Mo., Feb. 10—The highest price paid for zinc sulphide ore was $49, the base price, per ton of 60 per cent. zinc, $43@46. Zinc silicate sold on a base of $23@26 per ton of 40 per cent. zinc. The average price, all grades of zinc, was $42.38. As high as $53 per ton was reported paid for one bin of lead ore, the general market being close to $52, with some ore selling down to $46 at the week-end. The average price, all grades of lead, was $52 per ton.

The weather was good for mining and milling ore, but in the scattered cases

SHIPMENTS, WEEK ENDED FEB. 10

	Blende	Calamine	Lead Ore	Value
Webb City-Carterville	4,223,820	.....	516,320	$104,233
Joplin	1,721,210	.....	276,260	45,910
Alba-Neck	687,230	.....	.....	15,805
Galena	575,830	.....	89,020	14,695
Oronogo	500,120	.....	123,810	14,180
Granby	62,000	670,800	11,430	11,800
Duenweg	526,290	.....	.....	11,314
Carl Junction	382,790	.....	.....	9,185
Miami	170,050	.....	88 100	5,350
Spurgeon	58,630	221,100	35,980	5,255
Wentworth	191,260	.....	.....	4,016
Aurora	120,890	66,000	.....	3,460
Lawton	87,560	.....	40,840	2,955
Cave Springs	116,900	.....	.....	2,570
Jackson	64,010	.....	.....	1,375
Totals	9,488,590	957,900	1,181,760	$252,113
6 weeks	52,604,810	3,263,830	8,388,120	$1,449,078
Blende val., the week, $206,985; 6 weeks, $1,162,657				
Calamine, the week, 14,372; 6 weeks, 44,404				
Lead value, the week, 30,753; 6 weeks, 242,017				

where hand cleaning is still in vogue, it was too cold for concentrating. Still there was a lull in the production of both minerals, and this apathy is partly attributed to the slump in lead ore. The week should have shown an output of 5500 tons zinc ore, but will scarcely exceed 5000 tons, and may not reach that figure when all returns are in. The shipment of 5223 tons of zinc was a decrease of 396 tons. In lead was the great decrease in shipments, with 591 tons shipped, a decrease of 507 tons.

MONTHLY AVERAGE PRICES

Month	Zinc Ore				Lead Ore	
	Base Price		All Ores		All Ores	
	1911	1912	1911	1912	1911	1912
January	$41.85	$44.90	$40.55	$43.54	$55.68	$58.92
February	40.21	.....	39.16	.....	54.46	.....
March	39.85	.....	38.45	.....	54.57	.....
April	38.88	.....	37.47	.....	56.37	.....
May	38.25	.....	36.79	.....	55.21	.....
June	40.50	.....	38.18	.....	56.49	.....
July	40.75	.....	38.36	.....	58.81	.....
August	42.50	.....	41.28	.....	60.74	.....
September	42.63	.....	41.29	.....	59.33	.....
October	42.38	.....	40.89	.....	54.72	.....
November	45.40	.....	43.25	.....	57.19	.....
December	44.13	.....	40.76	.....	62.03	.....
Year	$41.45	.....	$39.90	.....	$56.76	.....

NOTE—Under zinc ore the first two columns give base prices for 60 per cent. zinc ore; the second two the average for all ores sold. Lead ore prices are the average for all ores sold.

Chemicals

New York, Feb. 14—The general market is beginning to show a moderate degree of improvement, without any marked change.

Copper Sulphate—The market is beginning to show the effect of the usual spring demand, and sales are improving. Prices are firm at last figures, $4.90 per 100 lb. for carload lots, and $5.15 per 100 lb. for smaller orders.

Nitrate of Soda—Business has been inclined to quiet, but there is no change in current prices and futures are a shade firmer. Quotations are 2.20c. per lb. for spot, and 2.20c. for all future positions.

Arsenic—Demand is good and prices are a little firmer, $2.62½@2.87½ per 100 lb. being asked for white arsenic.

Potash Salts—Exports of potash salts from Germany, year ended Dec. 31, metric tons:

	1910	1911	Changes
Kainit, kieserit, etc.	1,181,208	1,154,974	D. 26,234
Potassium chloride	270,237	329,734	I. 59,497
Potassium sulphate	76,285	109,555	I. 33,270
Pot.-magnesium sul.	197,408	282,574	I. 85,166
Total	1,725,138	1,876,837	I. 151,699

Of the exports in 1911 a total of 1,042,558 tons went to the United States.

Petroleum

The production of petroleum in California for the year ended Dec. 31, is reported at 83,744,044 bbl.; deliveries for consumption, 72,933,793 bbl.; surplus added to stocks, 10,810,251 bbl. By districts, the largest production was 21,584,602 bbl. in the Midway field. By months the heaviest production was 7,446,041 bbl. in December.

Mining Stocks

New York, Feb. 14—On Feb. 8 trading on the Exchange was exceedingly dull and price changes small. On the Curb copper shares were active and strong. Nevada gold stocks were in some demand, while Cobalt stocks showed some gains. There were sales of Homestake at $88.25@89 per share.

Feb. 9 the Exchange continued quiet, with no particular changes. On the Curb there was moderate trading in coppers, Butte Coalition, Mason Valley and Ray Central being prominent. There was good buying of Porcupine stocks.

Feb. 10 there were no special changes on either the Curb or the Exchange. Feb. 12 was a holiday.

Feb. 13 the market opened rather weak, but later recovered and there were small advances on moderate trading. The Curb dealt rather freely in copper shares, at fractional advances; but other mining stocks were quiet. Feb. 14 the market remained much the same, with no special tendency and moderate dealings at small advances.

At auction in New York, Feb. 8, a first-mortgage 5 per cent. bond of the West Kentucky Coal Co. for $1000 brought 76 per cent. of par; 5500 shares Royal Tinto Mining & Smelting Co. common stock, $25 for the lot.

Boston, Feb. 13—The appearance of the Copper Producers' statement last week gave the metal-share market quite a lift and considerable animation for that day only. This has been particularly disappointing, for the rank and file believe in higher prices for copper shares and deprecate the lack of initiative on the part of big interests, and the absence of leadership. Some of the Lake Superior issues take on periods of activity and strength at times, but the movements are not sustained, and have the appearance of professional dealings in the main.

Notably in this class has been Franklin, with a $1.25 rise to $13.50, and Winona, which advanced $2.37½ to $7. A quietus has come to the late activity of Old Colony and Mayflower stocks, although drill work continues. Isle Royale continues among the leaders and spurted $2.50 to $24. Among the porphyries Inspiration and Mason Valley hold attention. Local interests state that a consolidation of Ray Consolidated and Ray Central is being perfected.

Curb trading has been quiet. Eagle & Blue Bell was a feature, with an advance to above $1. The Rhode Island Coal Co. will issue receiver's certificates to pay current bills.

COPPER PRODUCTION REPORTS.
Copper contents of blister copper, in pounds.

Company	Nov.	Dec.	Jan.
Alaska shipments	1,274,655	4,995,008	3,701,010
Anaconda	20,850,000	.....	26,350,000
Arizona, Ltd	2,960,000	3,100,000	3,200,000
Balaklala	.....	.....	.....
Copper Queen	6,946,775	8,365,265	6,748,264
Calumet & Ariz	4,390,000	4,486,000	4,544,000
Detroit	1,941,498	1,969,313	1,941,970
East Butte	983,405	.....	.....
Mammoth	1,793,181	1,721,404	.....
Mason Valley	.....	.....	600,000
Miami	.....	2,500,000	.....
Nevada Con	5,207,983	4,679,674	.....
Old Dominion	2,082,000	2,610,000	2,044,000
Ray	2,517,000	2,660,000	.....
Shannon	1,256,000	.....	1,550,000
South Utah	361,681	267,514	189,678
United Verde*	2,500,000	2,000,000	.....
Utah Copper Co	9,117,961	9,039,557	.....
Lake Superior*	18,600,000	17,500,000	.....
Non-rep. mines*	11,483,000	.....	.....
Total production	94,265,139	.....	.....
Imports, bars, etc.	17,224,725	21,101,256	.....
Total blister	111,489,864	.....	.....
Imp. in ore & matte	4,767,217	5,159,997	.....
Total	116,257,081	.....	.....
Brit. Col. Cos.:			
British Col. Copper	.....	.....	.....
Granby	.....	.....	.....
Mexican Cos.:			
Boleo	.....	2,645,640	2,315,040
Cananea	.....	3,706,000	3,552,000
Moctezuma	1,682,768	2,864,464	2,732,867
Other Foreign:			
Cape Cop., S. Africa	857,920	.....	.....
Kyshtim, Russia	1,170,000	1,570,000	.....
Spassky, Russia	685,440	721,280	.....
Famatina, Argen.	174,720	217,280	.....
Exports from:			
Chile	4,704,000	5,824,000	8,064,000
Australia	7,168,000	11,200,000	7,056,000
Arrivals in Europe from other count.†	12,064,640	16,331 840	13,144,320

Figures are reports received from companies, unless otherwise stated. Boleo copper does not come to American refiners.
*Estimated. †Does not include the United States, Australia or Chile.

STATISTICS OF COPPER.

Month	United States Product'n	Deliveries, Domestic	Deliveries for Export
I, 1911	115,696,591	42,078,557	53,208,739
II	109,828,297	50,518,998	45,111,019
III	130,532,080	66,080,789	59,081,127
IV	118,085,223	52,407,650	62,129,599
V	126,962,544	64,543,963	61,978,557
VI	124,554,312	61,655,561	71,460,519
VII	112,167,934	56,982,582	74,880,658
VIII	125,493,667	59,935,364	69,855,660
IX	115,588,950	57,311,584	50,824,011
X	118,255,442	64,068,307	60,084,349
XI	111,876,601	68,039,776	67,049,279
XII	122,896,697	65,988,474	79,238,716
Year, 1911	1,431,938,338	709,611,605	754,902,233
I, 1912	119,337,753	62,343,901	80,167,904

VISIBLE STOCKS

	United States	Europe	Total
II, 1911	142,439,490	236,992,000	379,431,134
III	156,637,770	233,385,600	390,023,009
IV	162,007,934	223,014,400	385,022,434
V	165,555,908	212,284,800	377,840,708
VI	165,995,932	202,540,800	368,536,732
VII	157,434,164	195,932,800	353,366,964
VIII	137,738,858	191,891,840	329,630,698
IX	133,441,501	191,228,800	324,670,301
X	140,894,856	191,945,600	332,840,456
XI	134,997,642	176,825,600	311,823,242
XII	111,785,188	164,281,600	276,066,788
I, 1912	89,454,695	158,323,200	247,777,895
II	66,280,643	154,851,200	221,131,843

Figures are in pounds of fine copper. U. S. production includes all copper refined in this country, both from domestic and imported material. Visible stocks are those reported on the first day of each month, as brought over from the preceding month. Stocks at Hamburg and Rotterdam are included in the visible stocks for Europe.

Salt Lake City—At the annual meeting of the Stock & Mining Exchange, the governing board for the year was elected as follows: R. J. Evans, president; W. J. Browning, R. K. Cobb, A. L. Jacobs, J. L. Karr, W. D. Nebeker, C. W. Pratt, E. G. Woolley, Jr. and A. Thomas.

Assessments

Company	Delinq	Sale	Amt
Algomah, Mich	Jan. 22		$1.00
Alpha Con., Nev	Feb. 21	Mar. 13	0.05
Alta, Nev	Jan. 26	Feb. 16	0.05
Andes, Nev	Feb. 7	Feb. 28	0.05
Black Jack, Utah	Feb. 6		0.01
Boston Ely, Nev	Jan. 18		0.50
Confidence, Nev	Jan. 16	Feb. 6	0.20
Con. Imperial, Nev	Jan. 16	Feb. 7	0.01
Crown Point, Utah	Feb. 15	Mar. 11	0.005
Exchequer, Nev	Feb. 14	Mar. 6	0.05
Gold Springs, Nev	Jan. 17	Feb. 3	0.04
Gould & Curry, Nev	Jan. 24	Feb. 13	0.05
Hancock Con., Mich	Jan. 10		1.00
Hancock, Mich	Mar. 28		1.00
Kentuck, Nev	Feb. 29	Mar. 19	0.05
King David, Utah	Feb. 13	Mar. 6	0.005
Lehi Tintic, Utah	Feb. 29		0.01
Ojibway, Mich	Jan. 10		1.00
Raven, Mont	Feb. 1		0.10
Savage, Nev	Feb. 14	Mar. 7	0.10
Sierra Nevada, Nev	Jan. 23	Feb. 13	0.10
Southwestern Miami, Ariz	Jan. 15		1.00
Spider, Utah	Jan. 15	Feb. 15	0.002½
Swansea Con., Utah	Jan. 17	Feb. 8	0.01
Tintic Standard, Utah	Jan. 8	Feb. 5	0.00
Union Con., Nev	Feb. 20	Mar. 12	0.15
Utah, Nev	Jan. 19	Feb. 9	0.05
Yellow Jacket, Nev	Jan. 31	Mar. 6	0.10

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1910	1911	1912	1910	1911	1912
January	52.375	53.795	56.260	24.154	24.865	25.887
February	51.534	52.222		23.794	24.081	
March	51.454	52.745		23.690	24.324	
April	53.221	53.325		24.483	24.595	
May	53.870	53.308		24.797	24.583	
June	53.462	53.043		24.651	24.486	
July	54.150	52.630		25.034	24.286	
August	52.912	52.171		24.428	24.082	
September	53.295	52.440		24.567	24.209	
October	55.490	53.340		25.596	24.594	
November	55.635	55.719		25.680	25.649	
December	54.428	54.905		25.160	25.349	
Year	53.486	53.304		24.670	24.592	

New York quotations, cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

Month	New York				London, Standard	
	Electrolytic		Lake			
	1911	1912	1911	1912	1911	1912
January	12.295	14.094	12.680	14.337	55.600	62.760
February	12.256		12.611		54.974	
March	12.139		12.447		54.704	
April	12.019		12.275		54.034	
May	11.989		12.214		54.313	
June	12.385		12.611		56.365	
July	12.463		12.720		56.673	
August	12.405		12.634		56.266	
September	12.201		12.508		55.253	
October	12.189		12.370		55.170	
November	12.616		12.769		57.253	
December	13.552		13.768		62.068	
Year	12.376		12.634		55.973	

New York, cents per pound, London, pounds sterling per long ton of standard copper.

TIN AT NEW YORK

Month	1911	1912	Month	1911	1912
January	41.255	42.529	July	42.400	
February	41.614		August	43.319	
March	40.157		September	39.755	
April	42.185		October	41.185	
May	43.115		November	43.125	
June	44.606		December	44.655	
			Av. Year	42.281	

Prices are in cents per pound.

LEAD

Month	New York		St. Louis		London	
	1911	1912	1911	1912	1911	1912
January	4.483	4.435	4.334	4.327	13.009	15.619
February	4.440		4.266		13.043	
March	4.394		4.238		13.122	
April	4.412		4.262		12.881	
May	4.373		4.223		12.984	
June	4.435		4.292		13.260	
July	4.499		4.397		13.530	
August	4.500		4.406		14.260	
September	4.485		4.356		14.744	
October	4.265		4.139		15.332	
November	4.298		4.181		15.821	
December	4.450		4.332		15.648	
Year	4.420		4.286		13.970	

New York and St. Louis, cents per pound. London, pounds sterling per long ton.

SPELTER

Month	New York		St. Louis		London	
	1911	1912	1911	1912	1911	1912
January	5.452	6.442	5.302	6.292	23.887	26.642
February	5.518		5.368		23.276	
March	5.563		5.413		23.016	
April	5.399		5.249		23.743	
May	5.348		5.198		24.375	
June	5.520		5.370		24.612	
July	5.695		5.545		25.006	
August	5.953		5.803		26.801	
September	5.869		5.719		27.750	
October	6.102		5.951		27.256	
November	6.380		6.223		26.795	
December	6.301		6.151		26.849	
Year	5.758		5.608		25.281	

New York and St. Louis, cents per pound. London, pounds sterling per long ton.

PIG IRON AT PITTSBURG

	Bessemer		Basic		No. 2 Foundry	
	1911	1912	1911	1912	1911	1912
January	$15.90	$15.12	$14.40	$13.32	$14.75	$14.00
February	15.90		14.50		14.81	
March	15.90		14.65		14.96	
April	15.90		14.65		15.00	
May	15.90		14.30		14.72	
June	15.90		14.06		14.56	
July	15.90		14.03		14.53	
August	15.90		14.00		14.47	
September	15.90		13.57		14.40	
October	15.43		13.44		14.34	
November	14.92		13.30		14.25	
December	15.15		13.10		13.90	
Year	$15.72		$13.94		$14.49	

STOCK QUOTATIONS

COLO. SPRINGS Feb. 13

Name of Comp.	Bid.
Acacia	.05¾
Cripple Cr'k Con	.02½
C. K. & N.	.15
Doctor Jack Pot	.05½
Elkton Con	.62½
El Paso	.70
Findlay	.05
Gold Dollar	.15
Gold Sovereign	.02½
Isabella	.14½
Jack Pot	.05½
Jennie Sample	.06
Lexington	.01½
Moon Anchor	.01½
Old Gold	.03½
Mary McKinney	.53
Pharmacist	.02
Portland	.90
Vindicator	.65
Work	.02½

SALT LAKE Feb. 13

Name of Comp.	Bid.
Beck Tunnel	.13
Black Jack	.12½
Carisa	‡.16
Cedar Talisman	.02½
Colorado Mining	.36½
Columbus Con	.26
Daly-Judge	5.70
Grand Central	.85
Iron Blossom	1.22½
Little Bell	.35
Lower Mammoth	.03
Mason Valley	12.25
May Day	.15
Nevada Hills	2.35
New York	.06¾
Prince Con	1.02½
Silver King Coal'n	1.40
Sioux Con	.10½
Uncle Sam	.31½
Yankee	.15

TORONTO Feb. 13

Name of Comp.	Bid	Name of Comp.	Bid
Coniagas	6.50	Pearl Lake	.20½
Hudson Bay	‡70.00	Porcu. Gold	.44
Temiskaming	.34	Porcu. Tisdale	.03
Wettlaufer-Lor	.77	Preston E. D.	.06
Apex	.07	West Dome	‡.40
Central	‡3.62½	Standard	.20
Dobie	.60	Foley O'Brien	.32
Dome Exten	.42	Rea	1.05
Hollinger	11.54	Crown Chartered	.13
Imperial	.04	Swastika	.24

SAN FRANCISCO Feb. 13

Name of Comp.	Clg.
COMSTOCK STOCKS	
Alta	.02
Belcher	.55
Best & Belcher	.15
Caledonia	2.40
Challenge Con	.18
Chollar	.13
Confidence	.74
Con. Virginia	.81
Crown Point	.55
Gould & Curry	.06
Hale & Norcross	.23
Mexican	3.62½
Occidental	.50
Ophir	.42½
Overman	1.40
Potosi	.09
Savage	.28
Sierra Nevada	.36
Union Con	1.07½
Yellow Jacket	.56

Name of Comp.	Bid
MISC. NEV. & CAL.	
Belmont	8.77½
Jim Butler	.35
MacNamara	.24
Midway	.26
Mont.-Tonopah	1.00
North Star	.30
West End Con	.79
Atlanta	.17
Booth	.05
C.O.D. Con	.12
Comb. Frac	.15
Jumbo Extension	.20
Pitts.-Silver Peak	1.22½
Silver Pick	.06
St. Ives	.34
Tramp Con	‡.01
Argonaut	‡2.50
Bunker Hill	‡3.00
Cent. Eureka	.35
So. Eureka	5.50

N. Y. EXCH. Feb. 13

Name of Comp.	Clg.
Amalgamated	63½
Am. Agri. Chem	59¾
Am.Sm.&Ref.,com	71
Am. Sm.& Ref., pf.	104
Am. Sm. Sec., pf. B	86
Anaconda	35½
Batopilas Min	1¾
BethlehemSteelpf	59¾
Chino	25⅞
Federal M.& S., pf.	40
Goldfield Con	4½
Great Nor., ore ctf.	38⅛
Homestake	87
Miami Copper	23¼
Nat'nalLead,com.	53¾
National Lead, pf.	108
Nev. Consol	18¾
Pittsburg Coal, pf.	76
Ray Con	16¾
RepublicI&S,com.	20
Republic I & S, pf.	74½
SlossSheffi'd,com.	40
Sloss Sheffield, pf.	‡108½
Tennessee Copper	35⅛
Utah Copper	55½
U. S. Steel, com	60½
U. S. Steel, pf	107⅜
Va. Car. Chem	54

N. Y. CURB Feb. 13

Name of Comp.	Clg.
Barnes King	‡.35
Beaver Con	.48
Braden Copper	5½
B. C. Copper	4⅛
Buffalo Mines	1.20
Butte & Vipond	‡.53
Butte Coalition	22⅜
Cobalt Central	‡.01
Con. Ariz. Sm	⅝
Davis-Daly	1⅛
Diam'field-Daisy	10
Ely Con	⅛
Florence	.60
Giroux	4⅜
Gold Hill Con	1/16
Greene Cananea	8
Greenwater	.08
Guggen. Exp	180
Inspiration Con	18⅝
Internat. S. & R.	‡124
Kerr Lake	2⅛
La Rose	37/8
McKinley-Dar-Sa	1¾
Min. Co. of A. new	4
Nev. Utah M. & S.	1/16
Nipissing Mines	7⅛
Ohio Copper	1⅛
Pacific Sm. & M.	1/16
Porcupine T'nsite	‡.03½
Precious Metals	‡1⅜
Ray Central	2
Red Warrior	‡1½
South Utah M. & S.	¾
Standard Oil (Old)	625
Stand'd Oil of N.J.	330
Stand'd Oil Subs.	335
Stewart	1⅛
Tonopah	7⅛
Tonopah Ex	1⅝
Tri-Bullion	1/32
Tularosa	‡3½
Yukon Gold	3⅜

LONDON Feb. 14

Name of Com.	Clg.
Camp Bird	£1 12s 0d
Dolores	1 10 0
El Oro	0 17 3
Esperanza	2 2 6
Mexico Mines	7 2 6
Oroville	0 5 9
Stratton'sInd.	0 3 1½
Tomboy	1 2 6

BOSTON EXCH. Feb. 13

Name of Comp.	Clg.
Adventure	5⅝
Algomah	6½
Allouez	39½
Am. Zinc	25
Ariz. Com., ctfs.	4
Bonanza	.45
Boston & Corbin	6¾
Butte & Balak	4½
Calumet & Ariz	60
Calumet & Hecla	414
Centennial	18½
Con. Mercur	.03
Copper Range	52
Daly West	5½
East Butte	12¾
Franklin	12¾
Granby	35
Hancock	35
Hedley Gold	.18
Helvetia	1¾
Indiana	13¾
Island Cr'k, com	43½
Island Cr'k, pfd	86½
Isle Royale	23¾
Keweenaw	1⅞
Lake	34½
La Salle	4½
Mass	7¼
Michigan	3
Mohawk	53
New Arcadian	3⅞
New Idria Quick	‡7¾
North Butte	26
North Lake	5½
Ojibway	5
Old Dominion	45
Osceola	109½
Quincy	74
Shannon	9½
Shattuck-Ariz	17½
Superior	24½
Superior & Bost.	3¾
Tamarack	27
Trinity	5½
Tuolumne	3¾
U. S. Smelting	35¼
U. S. Smelt'g, pf.	47½
Utah Apex	3
Utah Con	15¼
Victoria	4¾
Winona	6½
Wolverine	98
Wyandot	2¼

BOSTON CURB Feb. 13

Name of Comp.	Last
Ahmeek	240
Bingham Mines	3½
Boston Ely	1¼
Boswyocolo	.09
Cactus	.12
Calaveras	2 1/16
Chief Cons	.85
Corbin	2⅞
Cortez	1 1/16
Crown Reserve	3
First Nat. Cop	2 1/16
Majestic	.43
Mazatan	⅛
Moneta Porc	.14
Nevada-Douglas	3½
New Baltic	3⅜
Oneco	3
Raven Copper	.32
Rhode Island Coal	.27
San Antonio	‡3½
South Lake	5½
Trethewey	.70
Union Mines	1¼
United Verde Ext.	.36
Vulture	‡5½

‡Last quotation.